ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Vol. XXIV. No. 50.

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ENGLISH RAILWAY SCHEMES to be presented at the approaching session of Parliament, will include some of more than usual interest. An independent line into London from the north is projected by the Manchester, Sheffield & Lincolnshire Ry. Co., and this will, of course, be very strongly opposed by the other northern trunk lines entering the metropolis; the new line will be only 80 miles long, extending from the company's system at Nottingham to Aylesbury, where it will connect with one of the extensions of the Metropolitan Ry., over which it will run into London, where extensive terminals will be provided. A new scheme is the Dover & Calais Submarine Tubular Ry., which is to consist of two tubes or tunnels laid on the bed of the channel, a scheme which is very old. The Channel Bridge Co. will ask the power to build a harbor for its own use. The South London Ry., whose underground electric line has recently been opened, will apply for authority to extend its line to the northern part of London. The Central London Ry., which is to be an underground electric line crossing the city from east to west, and which was thrown out last session for the reason that it was too extensive a line on which to experiment with electricity, will again be brought up, and the success of the South London Ry. will be used as a powerful argument in its favor. A cross-country line is projected from King's Lynn, on the east coast, to Liverpool, on the west.

THE GREAT TUNNEL of the Ontario & Scranton branch of the Ontario & Western, to do away with the series of reverse curves by which a mountain slope is now crossed, is nearly finished. The approaches to the tunnel at either end are 2,000 ft. long, and the tunnel proper is 1,578 ft. long, most of the cutting being through solid rock. It is expected the cuttings will meet at the center of the mountain about Jan. 1, and in the spring the tunnel will be opened for traffic. The advantages which the company will gain are the reduction of the maximum grade at that point from 104 to 75 ft. and the shortening of the main line of road between Sidney and Walton by about two miles and the saving of 15 minutes in the time of passenger trains. The estimated cost of the improvement is about $600,000.

LIVERPOOL is building its first overhead electric railway. The line will be 5¼ miles long when completed and the columns have been erected for over one mile. The line will be worked by electric locomotives, says the London *Electrical Engineer*.

THE COMMITTEE ON AIR BRAKE STANDARDS AND INSTRUCTIONS of the Master Car Builders' Association has issued the following circular of inquiry:

How many freight equipment cars have you equipped with M. C. B. standard air brake details, *practically* like those shown in Plate X, proceedings 1890?

How many of the same cars are equipped with iron brake beams?

How many freight equipment cars have you equipped with iron brake beams, and with brake details different from those above mentioned?

Do you think that good results can be had and maintained by any form of wooden brake beam with modern air brake equipment, or do you consider that iron brake beams are necessary for good results and economy?

Representative members are requested to reply to above questions to JOHN S. LENTZ, Chairman of Committee, at Packerton, Pa., before Jan. 1, 1891.

A NEW ELECTRIC LIGHTING SYSTEM FOR RAILWAY CARS is to be placed on the market some time during the year 1891 by the Consolidated Car Heating Co. In an announcement issued by the company it is stated that each car will have an independent source of light which will be available even when the car is at rest for five hours, or perhaps longer. The tax upon the motive power will be slight and indirect, no steam being used. The designers are now endeavoring to so simplify and cheapen the apparatus that it shall be, both in first cost and in running expense, more economical than any lights now used in first-class cars. From the above it may be gathered that the system will include storage batteries and a dynamo on each car, the latter driven from the car axle.

FORGED CAR WHEELS are to be made by a new process by a Pittsburg firm, according to press accounts. The wheels are to be forged from ingots of open-hearth steel. A series of dies under steam hammers will gradually develop the perfect wheel. The first experiments are reported as satisfactory and a plant for manufacture is promised at an early date.

THE JERSEY CITY IMPROVEMENTS OF THE PENNSYLVANIA R. R. are rapidly progressing, considering the awkward conditions of construction. The elevated structure (illustrated in ENGINEERING NEWS, June 25, 1887) is erected for two of the tracks; and it is expected that trains will be run over this part in February, when the other half will be put up. About 300,000 cu. yds. of earth have been used in embankment for the fan-shaped arrangement of depot tracks, or drill yard. In all 12 tracks will run into the new depot. The latter will be 256 ft. wide by 600 ft. long, independent of waiting rooms, ferry building, etc. Work began this week on the erection of the iron work. At the Mount Pleasant yard, near Bergen Hill, the new roundhouse is completed, and large storehouses, repair shops, dynamo plant, turn-tables, etc., are erected at the same place.

A NEW IDEA IN WEIGHING FREIGHT CARS has been worked out by an Indianapolis inventor, Mr. C. B. WANAMAKER. Instead of running cars over a track scale to determine the weight of their contents, it is proposed to place a system of scale levers beneath the floor of each car. When it is desired to weigh the contents of a car the fulcrums of the scale levers are lifted by four hydraulic jacks so that the weight of the car body is carried on the scale levers. The gross weight is then determined on the scale beam placed at the center of the car. When the scale is not in use the weight does not come on the scale levers, so the knife edges do not become worn.

No doubt it would be a convenience to traffic departments to be able to determine the weight of a freight car's lading at all times and places; but the urgency of the case would hardly warrant the attachment to every freight car of a system of scale levers of 30 tons capacity, with four hydraulic jacks. The inventor omits to state the net cost of his device, but hydraulic machinery is not especially inexpensive, and his scale levers will require a good many pounds of iron. In fact, the additional weight which the scale would add to every car would amount to considerably more on the average than the extra weight of freight in overloaded cars whose haulage the invention is to save. The inventor who would devise a successful weighing apparatus for attachment to every freight car must secure extraordinary lightness and cheapness first of all.

THE COMPOUND LOCOMOTIVE for the Mexican National Ry., which has been built at the Baldwin Locomotive Works, is of the ten-wheel type. The gauge is 3 ft.; cylinders, 10 × 20 ins. and 17 × 20 ins.; driving wheels, 40 ins. diameter; total wheel base, 21 ft. 5 ins.; driving wheel base, 12 ft.; total weight, 74,000 lbs.; weight on driving wheels, 54,000 lbs.; diameter of boiler, 48 ins.; 132 tubes 2 ins. diameter and 11 ft. 9⅛ ins. long; firebox, 83⅛ ins. long, 24⅝ ins. wide, 55¾ ins. deep at the front and 44¼ ins. deep at the back; water space, 3½ ins. at front, 2½ ins. at sides and back; radial staying. The truck wheels are 26 ins. diameter, with journals 4¼ × 8 ins.; driving wheel centers, 40 ins.; driving axle journals, 6½ × 7 ins. The tender is carried on two four-wheel diamond trucks, with 30-in. wheels and journals 4¼ × 8 ins.; it has a capacity of 3,000 galls. The engine is of the four-cylinder compound type patented by the Baldwin Works, and already described in ENGINEERING NEWS. It is fitted with the Westinghouse brake.

COMPOUND LOCOMOTIVES for Mexico and South America are being built in this country. The Baldwin Locomotive Works, of Philadelphia, Pa., have built a ten-wheel engine for the Mexican National Ry. They are also building for the Paulista Ry., of Brazil, three compound American (eight-wheel) type passenger locomotives, equivalent to high-pressure engines with cylinders 16 × 24 ins.; and a compound consolidation engine, equivalent to a high pressure engine with cylinders 20 × 24 ins. For the Oeste de Minas Ry., of Brazil, they are building two narrow gauge compound engines, one of the eight-wheel and one of the ten-wheel type. They have recently shipped a narrow gauge compound engine of the consolidation type to the extension of the Bahia Ry., of Brazil. This engine is illustrated on another page.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a crossing collision, Dec. 4, at Jacksonville, Ill. The rear sleeper of an express train on the Chicago & Alton R. R. was run into by a freight train of 20 loaded coal cars on the Wabash R.R.; the crew of the freight train are said to have lost control of the train on the steep grade down to the crossing. Some accounts state that the passenger train was just starting from the depot, while others state that it was standing on the crossing; the engine driver tried to pull his train across, but had not time to get it clear. Two persons were killed and 3 or 4 injured. The accident appears to have been very similar to that reported in our issue of Nov. 15. By the mistake of a switchman at Lachine, Que., on Dec. 4, a Grand Trunk Ry. express was turned on to a wharf line and the engine went into the river; one man was killed. Another misplaced switch accident occurred on Dec. 4 at the junction of the West Jersey and Atlantic City railways, at Camden, N. J.; a freight train was turned on a blind siding used for the protection of the crossing and both roads were blocked. It is stated that the switchman in the tower was asleep, and being suddenly awakened by a whistle from the engine pulled the wrong lever.

THREE EXPLOSIONS OF LOCOMOTIVE BOILERS are reported. The boiler of a Philadelphia & Reading R. R. engine exploded Dec. 8; the engine was standing in the roundhouse at Philadelphia, and the explosion is said to have been caused by low water. On Dec. 8 the boiler of a Lehigh Valley R. R. engine exploded at Dale, N. Y., and was hurled 70 ft. from the engine; 2 men were killed. The boiler of freight engine No. 69, of the New York, New Haven & Hartford R. R. exploded Dec. 9, at Wallingford, Conn., while the engine was standing at the station just after having taken water at the tank. Two men were injured.

THE NEW ROCHESTER, N. Y., BRIDGE over the Genesee River was formally opened to travel this week. It is a highway bridge designed by and erected under the supervision of Mr. L. L. BUCK, M. Am. Soc. C. E., of New York, and built by the Rochester Bridge & Iron Works, of Rochester, N. Y. The superstructure is a three-hinged arch of 428 ft. span, and two approaches of 103 and 93 ft. respectively. The roadway is about 212 ft. above the bed of the river and is 20 ft. wide in the clear, with two 8-ft. sidewalks. The superstructure weighs 1,800,000 lbs., of iron and steel, and the probable cost is $125,000. It was erected on false works, extending from the river bed, with a Howe truss spanning the channel.

Wind Pressures and the Measurement of Wind Velocities.

By Assistant Professor C. F. Marvin, U. S. Signal Service.

Measurement of Wind Velocities.—Within recent years several different experimenters have independently worked upon the problem of determining the relations between the rate of rotation of the cups of the Robinson anemometer and the velocity of the wind.

The most noteworthy experiments* have, without exception, been made upon whirling machines. In earlier experiments so many errors have arisen due to the influence exercised by the whirling machine in stirring up and setting the air itself in motion that considerable uncertainty exists in respect to results thus obtained. To avoid or at least lessen these errors it is necessary to use whirling machines of very large dimensions. In 1888 experiments with such apparatus were begun at about the same time in both England and the United States. The machine used by Messrs. Whipple and Dines in England was set up in the open air, and is still in use in carrying on in a very ingenious manner experiments upon wind pressures. The length of the whirling arm in this case is about 29 ft.

In the experiments made in this country under the direction of the Chief Signal Officer, and which were carried out under circumstances more favorable than any yet obtained, the arm of the whirling machine was 35 ft. long for many of the experiments and for others was shortened to 28 ft. This very large apparatus was placed in a completely closed court of large dimensions, and at the time of experimentation no air currents except those produced by the machine itself could be detected by the most delicate indicators. In these experiments the effects of currents set up by the motion of the whirling machine itself were very small, but were accurately determined by a new method, which, it is believed, gives the best results thus far obtained. A brief explanation may make the circumstances more clear. As the large whirler with the anemometer is made to revolve the air immediately surrounding it is pushed or dragged along with the arm to a certain extent, so that the actual movement of the anemometer through the air is somewhat less than the apparent movement. This actual movement was measured by placing a very small and delicate special anemometer in front of the anemometer being tested and observing on the former the actual velocity of rotation of the arm. The constants of the delicate anemometer are, for this purpose, previously determined with great accuracy, a result easily obtained, as the small size of the anemometer not only admits of its being carried by a slender support at a distance of several feet from the whirling arm and entirely beyond the influence of disturbances produced by the arm, but the very rapid rate of revolution of the cups enables accurate measurements to be made in a very short time and with only one or two revolutions of the large whirler. A more complete discussion of the methods used and results obtained has been given in the "Signal Service Monthly Weather Review for February, 1889."

Subsequent to the experiments upon the whirling machine an extended study has been made of the comparison of different anemometers when similarly exposed in the open air. Very early in this study I was led to the belief that the very sudden and continuous changes of considerable magnitude in the velocity of ordinary winds led to a noticeably different action of the anemometer than would result from the influence of steady currents. So far as I am aware, this important element has not thus far been considered either in the development of a mathematical theory for the anemometer or in the final reduction of experimental results. Some mention and discussion of the subject first appeared in the *American Meteorological Journal*, of April, 1889.

As the matter only came to my attention after the experiments with the whirling apparatus were completed, it was impossible to make it a subject of direct experiment, but it is hoped to again take up the whirling machine work in anticipation of which a new line of experiment bearing directly upon this subject has been devised. The condition which it is necessary to secure is to propel the anemometer through still air with a highly and constantly varying velocity, for which purpose the whirling arm will be arranged with an independently revolving plate or reciprocating lever at the outer end, the resultant motion of which combination will have the desired irregular character.

In the absence of whirling machine experiments of this kind, the open air comparisons were reduced upon the basis that the sudden variations in wind velocities produce a less influence upon anemometers of compact proportion than upon those of slender proportions. The terms compact and slender, in this connection have reference to the relations existing between the diameters of the cups and the lengths of the arms. Anemometers whose arms measured from the cup centers to the axis are about two, or even more times, the diameter of the cups, are considered as of slender proportions, while those whose arms similarly measured are of a length only a little greater, or even less than the diameter of the cups, are said to be of compact proportions.

A discussion of the numerical results and equations derived from the open air comparisons may be found in the "Signal Service Monthly Weather Review for January, 1890."

The equations below are there given for the regular Signal Service anemometer, having cups 4 ins. in diameter on arms 6.72 ins. long:

(1) $V = .225 + 3.143v - .0362v^2$ (whirling machine).

(2) $V = .263 + 2.953v - .0407v^2$ (open air).

The velocities are in miles per hour; v being the linear velocities of the cup-centers.

Equation (2) may be considered as the equation of the Signal Service anemometer when exposed to the variable winds of the open air, while equation (1) is for the same anemometer exposed to perfectly steady winds. Quadratic equations of this form have been used by several investigators for expressing the anemometer law. They are quite irrational, however, and wholly inadequate. In equation (2), V becomes a maximum, for $v = \frac{2.953}{.0814}$, the interpretation of which leads to the irrational conclusion that after a certain high velocity the cups run less and less rapidly as the wind increases. It should be noted, of course, that the constants in these equations have beon computed from results at low velocities; that is, under 35 miles per hour.

Recognizing this defect of the quadratic equation, it was desired to secure a formula giving a more satisfactory extension beyond the limits of the experiments, and an equation of the following form was computed:

$$(3)\ \log. V = .509 + .9012 \log. v.$$

This equation is recommended for use in reducing all wind velocities observed by the Signal Service anemometer, and certain checks that have been recently obtained from wind pressure experiments, as given below, have shown the equation to be highly satisfactory.

Inasmuch as the Robinson anemometer is always constructed so that the graduations of the dials are in miles and fractions of miles, computed on the basis that the cup-centers move with a velocity one third that of the wind, the most convenient method of applying the above formula is by use of a table containing the observed velocity by the Robinson anemometer and the more accurate velocity from the formula.

The following is such a table:

Corrected Wind Velocities, as Indicated by Robinson Anemometer.

(Miles per hour.)

Indicated velocity (tens).	0	1	2	3	4	5	6	7	8	9
0	....	....	....	....	....	5.1	6.0	6.9	7.8	8.7
1	9.6	10.4	11.3	12.1	12.9	13.8	14.6	15.4	16.2	17.0
2	17 8	18.6	19.4	20.2	21.0	21.8	22.6	23.4	24.2	24.9
3	25.7	26.5	27.3	28.0	28.8	29.6	30.3	31.1	31.8	32.6
4	33.3	34.1	34.8	35.6	36.3	37 1	37.8	38.5	39 3	40.0
5	40 8	41.5	42.2	43.0	43.7	44.4	45.1	45.9	46.6	47 3
6	48 0	48.7	49 4	50.2	50.9	51.6	52.3	53.0	53.8	54.5
7	55.2	55.9	56.6	57 3	58.0	58 7	59.4	60.1	69 8	61.5
8	62.2	62.9	63.6	64.3	65.0	65.8	66.4	67.1	67.8	68.5
9	69.2	....	....	....	....	....	....	....	....	....

All observers in the United States using anemometers similar in construction to those of the Signal Service, will find the values in the above table much more accurate than those commonly used.

In addition to the wind pressure experiments, several days' continuous comparisons of anemometers of different sizes were also obtained at the summit of Mount Washington, under reduced atmospheric pressure and at unusual velocities; the exposure being upon the top of the wind-pressure apparatus, to be described below.

Three anemometers, each having 3-in. cups, but with arms 4, 6.7 and 7 ins. long, respectively, were compared, very high velocities being obtained on one occasion; so much so, in fact, as to carry away the anemometers, all three being torn from the support at apparently the same instant, the mean velocity just previous being about 80 miles per hour.

The results of these comparisons have agreed almost perfectly with more extended and complete comparisons referred to above, though the former were over a much less range of velocity. So far as these comparisons go, I find no evidence that the Robinson anemometer is noticeably influenced by considerable changes in the atmospheric pressure. There is little reason, however, to expect that such effects, did any exist, would be apparent in comparisons of this kind.

Wind Pressures.—Even at the present time of advanced experimental study of natural phenomena, our knowledge of the relations of wind pressure and velocities is very limited and incomplete. The most serious and perplexing disturbances appear to accompany investigations in this direction and accurate results have, perhaps, never been obtained. The last accounts of the experiments of Messrs. Whipple and Dines have just appeared in the September number of the Proceedings of the Royal Society. Notwithstanding the care exercised in conducting the experiments, the results in some respects, are irregular and inexplicable. The method used is only possible on the basis that the pressures vary as the square of the velocity, and the success of the experiments, so far as the method is concerned, leaves no doubt upon this question. The experiments made by Mr. Crosby, and given in the Engineering News for the latter part of June, 1890, indicated a linear law which must undoubtedly prove to be quite incorrect.

A few direct determinations of wind pressures upon large plates were made during August last at the summit of Mt. Washington. The methods used and the results obtained are given as follows:

The apparatus was exposed upon the top of a solidly built wooden tower about 40 ft. high and some 15 ft. square at the top. This occupied the highest point of the mountain, and afforded an unobstructed exposure for all winds from westerly and northerly directions. Southerly winds were somewhat interfered with by the presence of a low building in that direction, and the exposure for easterly winds was very bad owing to the proximity of the large hotel building. Only a very few experiments were made with southerly winds, the direction being westerly for all other experiments. No defect attributable to imperfect or unequal exposure has been discovered in the results. The diagonals of the tower were north and south and east and west, respectively. The apparatus occupied the westerly corner, and was so constructed that the plate was held in front of the sides of the tower by a distance of nearly 4 ft. The center of the plate was, moreover, a distance of nearly 6 ft. above the floor of tower.

The apparatus itself may be briefly described as consisting of a rigid vertical support of wrought iron pipe secured to the floor and held firmly in the corner of the railing about the tower. The anemometer was attached to a horizontal arm extending from the top of the support. The arm was adjusted to the direction of the wind and carried the anemometer in about the same vertical plane as the pressure plate, so that the wind arrived at the two at practically the same instant. The anemometer cups were about 4 ft. higher than the center of the pressure plate.

The horizontal arm carrying the pressure plate consisted of a wrought iron pipe secured to the main support in such a manner that it could be revolved on a vertical axis and brought into the direction of the wind. The pressure plate was not attached directly to this arm but to a larger tube of brass, which telescoped over the iron pipe. A nicely arranged system of highly polished steel balls was provided that permitted the brass tube and pressure

* Robinson, Phil. Trans., CLXIX., 1878, pp. 777-822.
Stokes, Proc. Roy. Soc., XXXIX., 1881, pp. 170-1888.
Dohrandt, Rep. für Met. Band, VI., No. 5.

plate to move horizontally over the iron tube with the greatest freedom. Steel springs of varying strengths arranged to be stretched by the wind pressure were used to oppose the motion of the plate. At the rear, some 5 ft. behind the pressure plate and attached to the main support, were the recording mechanisms arranged on the ordinary chronograph principles. A sliding pencil was connected directly to an extension from the pressure plate tube and recorded the amount of distension of the spring. the zero position being constantly indicated by a line traced by a stationary pencil. A third pencil operated by an electro-magnet was in electrical connection with the anemometer, which, as before stated, was of the regular signal service pattern and one that had been carefully studied in connection with anemometer experiments. The electrical contacts of this anemometer were made for each 50 revolutions of the cups, a quantity that corresponds to $\frac{1}{10}$th mile of wind movement, as computed by the Robinson formula. The chronograph cylinder revolved once in about a half hour, and was of such diameter as to give a movement of about 0.6 in. per minute.

In arranging this apparatus, it was found almost impossible to automatically keep the large pressure plate, with its accessories, directed to the wind, so that it was necessary to secure this condition by hand and eye observation, the direction being indicated by a light cotton thread exposed above the pressure plate. I am assured that no sensible error arises from this disposition of the apparatus, as the direction of the wind, broadly considered, was very constant, being subject only to small and sudden fluctuations about a mean direction.

The records of the pressure and velocity of the wind were, therefore, automatically and simultaneously recorded on the same sheet of paper. The curve of pressures, if it can be called a curve, presents, in spite of the comparatively rapid rate of rotation of the register, a very irregular appearance indeed. The oscillations do not, except for occasional instants, correspond to harmonic vibrations of the spring and pressure plate considered as a vibratory system, but are actual and real changes in wind pressure. The magnitude of these variations is itself, very irregular; but it may be stated to be approximately as much as 35% of the mean pressure. There is, in addition to these very rapid variations in the pressure which take place inside of a second or two of time, other variations which go through their irregular changes in from a few to several minutes' time.

These circumstances led me to the following method of reducing the observations: The traces on the record sheets were divided into portions representing, generally, four or five minutes of time, and during which the conditions were, to some extent, constant. The traces of the pressure were all gone over by hand and a red ink line drawn through the pencil mark in such a manner as to get a mean curve. In this, only those variations which were of such short period that the pencil marks were too close together to distinguish were evened up. All changes of larger period were followed accurately. The next step consisted in carefully measuring the area of each subdivision, including, of course, everything between the red ink trace and the line of zero pressure. This measurement was very satisfactorily made by a small planimeter. The mean pressure is now quite accurately found by dividing the area by the length of the base of the diagram. The mean wind velocity corresponding to the same portion of the sheet is determined from the simultaneous record of the anemometer. The large number of observations obtained in this way have been grouped in sets corresponding to the velocity and a final mean determined.

The tables in the next column contain these results for all the experiments made.

The velocity of the wind has been computed by three different formulæ, namely, the well-known Robinson formula:

$$V = 3v$$

in which v = the velocity of the cup centers, which values appear in the first column. The second and third columns contain velocities computed respectively by the two following formulas, already given, namely:

$$V = .263 + 2.95v - .0407v^2,$$

and

$$\log. V = .500 + .9012 \log. v.$$

SUMMARY OF WIND PRESSURES.
(Area of plate: 9 square feet.)
Mean barometer: 23.9.

Velocities, in miles per hour.			Total pressure, pounds.	Constants: $\frac{P}{V^2}$		
a Robinson.	*b* Quadratic.	*c* Logarithmic.		*a*	*b*	*c*
7.14	7.06	7.07	1.23	.0241	.0247	.0246
9.26	9.00	8.97	2.22	.0259	.0275	.0276
10.9	10.5	10.3	2.87	.0242	.0261	.0271
12.9	12.2	12.0	3.81	.0230	.0256	.0265
14.6	13.7	13.4	4.67	.0219	.0248	.0260
17.0	15.7	15.4	6.25	.0216	.0254	.0264
18.9	17.2	17.0	7.32	.0205	.0247	.0253
20.3	18.4	18.1	8.48	.0207	.0250	.0258
24.1	21.4	21.3	11.5	.0198	.0251	.0253
26.2	23.0	22.8	13.6	.0195	.0257	.0262
28.8	24.9	24.8	16.8	.0203	.0 71	.0273
31 6	26.8	27.0	18.9	.0189	.0253	.0258
33.1	27.9	28.1	20.6	.0187	.0265	.0261
37.4	30 7	31.5	25.9	.0185	.0275	.0261
38.9	31.7	32 5	26.7	.0177	.0267	.0252
40.5	32.7	33.7	27 8	.0170	.0260	.0244
55.6	41 1	44.8	53.0	.0172	.0314	.0265
57.5	41.8	46.2	55.6	.0169	.0318	.0261
58.6	42.5	46.9	57.0	.0166	.0316	.0258
60.7	43.4	48.5	60.6	.0165	.0322	.0258
Means					.02557	.02600
Constant, per square foot					.00285	

SUMMARY OF WIND PRESSURES.
(Area of plate: 4 square feet.)
Mean barometer: 23.9.

Velocities, in miles per hour.			Total pressure pounds.	Constants: $\frac{P}{V^2}$		
a Robinson.	*b* Quadratic.	*c* Logarithmi		*a*	*b*	*c*
6.96	6.88	6.90	.73	.0150	.0156	.0153
8.36	8.16	8.13	1.08	.0155	.0162	.0164
10.7	10.3	10.2	1.29	.0113	.0123	.0125
13.8	13.1	12.8	2.00	.0105	.0116	.0122
14.8	13.8	13.6	2.26	.0103	.0119	.0122
17.3	16.0	15.7	3.05	.0102	.0119	.0124
18.1	16.6	16.3	3.33	.0102	.0120	.0125
21.0	18.9	18.6	3.69	.0084	.0104	.0107
23.2	20.7	20.5	5.26	.0098	.0123	.0125
25.3	22.3	22.1	5.90	.0092	.0119	.0121
26.7	23.3	23.1	6.71	.0094	.0124	.0126
29.0	25.0	24.9	7.60	.0090	.0122	.0123
31.1	26.5	26.6	8.96	.0093	.0128	.0127
32.1	27.2	27.3	8.93	.0086	.0121	.0120
34 4	28.9	29.2	9.26	.0078	.0111	.0109
43.1	34.3	35 7	13.4	.0072	.0114	.0106
44.5	35.1	36.7	15.5	.0078	.0126	.0105
46.1	36.0	37.9	15.6	.0073	.0120	.0108
48.5	37.4	39.7	20 3	.0086	.0150	.0109
51.2	39.8	41.6	19 8	.0076	.0125	.0124
52.5	40.5	42.6	22.0	.0080	.0134	.0112
54.5	41.0	44.0	22.5	.0076	.0134	.0126
56.3	41.3	45.4	23.3	.0073	.0136	.0113
58.5	42.9	46.9	21.7	.0064	.0118	.0119
Means					.01177	
Constant, per square foot					.00295	

The last three columns of constants are computed on the assumption that the pressure of the wind varies as the square of the velocity, and corresponds, respectively, to the velocities in the first three columns. It is observed that this factor is not at all constant if velocities are taken by the Robinson formula, but that, for the quadratic equation, except for irregular variations due, it is believed, to errors of observation, the value is practically constant up to velocities between 25 and 30 miles, and that above this the values steadily increase. If the last column be considered, it appears that the values throughout are practically constant and the same as those of the upper portion of the preceding column. In a previous report upon anemometer studies, I have already expressed my conviction that velocities cannot be accurately computed by the quadratic equation for conditions higher than 30 miles per hour or thereabouts, and that the logarithmic formula was undoubtedly more accurate. These conclusions are strikingly confirmed in the wind pressure experiments here given, and I am, therefore, convinced that so far as can be determined from experiments of this kind, the pressure of the wind varies as the square of the velocity.

If we compare the corresponding results obtained with the 9 sq. ft. and the 4 sq. ft. plates, we find further that the pressure varies strictly in proportion to the area of the plate. A critical examination of the constants in the case of the 4 sq. ft. plate shows greater irregularity than that for the 9 sq. ft. plate. It should be noticed in this connection that a much greater number of observations were made with the 9 sq. ft. than the 4 sq. ft. plate; moreover, the first two and the last observation with the 4 sq. ft. plate have been queried, as they do not agree well with the other results. Some explanation of this is found in the fact that they are results of single observations only, while nearly all the other values are the mean of several observations.

It remains now to say that the mean barometric pressure during my experiments was 23.9, and that the final value of the constant, viz.: .0029, needs to be slightly altered in order to reduce to the condition of normal action of the wind. The actual direction of the wind, as before mentioned, was inclined upward, and this I found was also practically a constant quantity, particularly so as nearly all my experiments were made with the wind in one direction. The amount of this inclination, as nearly as it could be determined, may be taken at about 15°. We do not, perhaps, know very well the law of variation of pressure with angle of inclination, but I am disposed to increase the above factor in proportion to the $\cos^2$ of the angle of inclination, which gives .0032. I will assume further that the wind pressure is proportioned to the density of the air; therefore, the factor reduced to 30 ins. barometric pressure becomes .0040, and the formula for computing wind pressure under barometric pressures of 30 ins. may be expressed as follows:

$$P = .0040\ V^2 S$$

where V = wind velocity in miles per hour; P = the pressure in pounds per square foot, and S = the area of the plate.

This formula, being determined by direct comparison of the anemometer and pressure plate, can always be used whenever the velocity is measured by the Robinson anemometer. The coefficient .0040 differs from a generally accepted (Smeaton) value of .005, and from the value .0029, found by Messrs. WHIPPLE and DINES, by about the same amount, being between the two.

For engineering purposes this formula gives very closely, I think, the actual pressures corresponding to velocities computed by the logarithmic formula, as applied to the Robinson anemometer, and this is the instrument almost universally used for measuring wind movements. Where the Robinson anemometer, having its dials graduated to read miles, is used, the observed velocity can easily be reduced to the true velocity by the use of the table already given.

In estimating the strains to which engineering structures may be subjected by winds, the maximum pressures are, of course, the most important. The above formula gives a mean pressure corresponding to a mean wind velocity. It is important to note that momentary pressures as much as 35% in excess of the above mean pressure may continually occur and recur. If their rate of occurrence be at all synchronous with a natural time of vibration of the structure or any part thereof, remarkable effects may follow.

WASHINGTON, D. C., Oct. 13, 1890.

THE ST. PAUL MEMBERS of the Am. Soc. C. E., at a meeting held Dec. 12, recommended voting for Messrs. CHANUTE for President, FTELEY and HERMANY for Vice-Presidents, TRAUTWINE for Secretary, BOLLER for Treasurer, CHILDS, HERING, HERSCHEL, NORTH and WHINERY for directors.

Legal Decisions of Interest to Engineers.

Responsibility of Township Authorities for Bridge.—Where a railroad company upon the construction of its line takes a road which has been constructed across a creek, and in return for that privilege constructs a bridge which is accepted by the county commissioners, it becomes the duty of the township authorities to keep the approaches to the bridge in safe condition. (Dalton v. Upper Tyrone Tp., Supr. Ct. Penna., 20 At. Rep., 637).

Negligent Switching at Crossing.—Where railroad employés engaged in switching cars detach from a train several cars which have no appliance connected with them by means of which signals indicating their approach can be given, and permit them in charge of one brakeman to run down a grade with considerable velocity, in doing which they collide with a wagon which is crossing the track, the company is guilty of so heavy a degree of negligence that although the driver of a wagon was a trespasser and guilty of contributory negligence, he may still recover for the injuries sustained. (Ga. Pac. Ry. Co. v. O'Shields, Supr. Ct. Ala., 8 South. Rep., 248).

Temporary Absence of Conductor and Engineer from Train.—An employé of a railway company was killed as the result of a derailment of a train which was moving slowly in the switching yards of the company. The conductor and engineer were absent from the train at the time of the accident attending to their duties in another part of the yard. This in itself does not show negligence where it appears that those who were in charge of the train were competent to manage it, and did, in fact, manage it in the usual manner, and where there is nothing to indicate that either the experience of the engineer and conductor or any caution they might have exercised had they been present would have prevented the accident. (Louisville & N. Ry. Co. v. Coniff, Court of Appeals of Kentucky, 14 S. W. Rep., 543).

TABLES EXHIBITING THE COMPARATIVE FINANCIAL MANAGEMENT OF THE THREE LEADING ENGINEERING SOCIETIES.

TABLES 1, 2, 3.—LITERAL ABSTRACTS OF THE TREASURERS' REPORTS FOR THE SEVERAL SOCIETIES, IN FORM AND ORDER AS GIVEN BY EACH.
TABLE 4.—THE SAME TOTALS REARRANGED UNDER A COMMON ORDER AND CLASSIFICATION.
TABLE 5.—DEDUCTIONS FROM TABLE 4, SHOWING THE EXPENSES PER MEMBER OF COMMON ITEMS IN EACH SOCIETY.

TABLE I.

ABSTRACT OF THE EXPENSES OF THE AMERICAN INSTITUTE OF MINING ENGINEERS FOR THE PAST THREE YEARS, 1887-8-9.

ITEM.	1887.	1888.	1889.	Total.
1. Printing transactions	$2,244.73	$2,583.40	$2,214.24	$7,042.37
2. Printing pamphlet edition of papers	1,249.05	1,881.35	1,569.85	4,700.25
3. Printing author's edition of papers	54.35	717.08	411.75	1,183.18
4. Printing index to Vols. I.-XV	.....	1,001.41	.....	1,001.44
5. Printing list of members	139.50	123.50	152.50	415.50
6. Printing mailing list	38.75	17.00	73.25	129.00
7. Printing circulars, ballots, etc.	130.60	104.56	233.41	468.57
8. Binding Transactions, Vol. XV	880.21	925.77	942.78	2,728.76
9. Binding other vols., do.	115.75	221.95	306.60	644.30
10. Binding general index	.....	389.94	.....	389.94
11. Binding misc. exchanges	108.15	100.49	86.06	294.70
12. Engraving and electrotyping	1,197.00	1,556.50	1,224.90	3,978.40
13. Postage and P. O. Box rent	921.87	1,089.98	673.10	2,684.95
14. Incidental exp., mailing books	39.54	42.45	45.92	127.91
15. Stationery and letter postage	321.77	460.25	392.60	1,174.62
16. Rent of offices	800.00	800.00	800.00	2,400.00
17. Janitor's fees	114.00	114.00	102.00	330.00
18. Expressc harges, freight, etc.	113.94	753.31	544.25	1,411.50
19. Telegrams	16.92	10.57	31.45	58.94
20. Index of Vol. XV., proof-reading	100.00	100.00	100.00	300.00
21. Index of Vols. I.-XV., incl.	1,075.71	.....	.....	1,075.71
22. Storage of Transactions	151.01	129.73	138.51	419.25
23. Insurance	5.00	9.00	9.00	23.00
24. Coal purchased, etc.	25.00	23.00	59.67	107.67
25. Rent safe deposit box	5.00	.....	.....	5.00
26. Fitting up additional room	418.23	.....	.....	418.23
27. Small expenditures	59.59	89.52	88.23	237.34
28. Salaries of secretary, assistants, and stenographer	4,740.00	5,410.00	7,933.20	18,083.20
29. Expenses of secretary at meetings	929.14	402.40	580.84	1,912.38
30. Typewriting machine	100.00	.....	.....	100.00
Totals	$16,074.81	$19,057.19	$18,714.11	$53,846.11
Pages of publications	994	857	940	2,791
No. of inset plates	10	7	13	30
No. members at beginning and end of year and average	1,585 1,714 1,650	1,714 1,830 1,772	1,830 1,968 1,899	1,740

TABLE 2.

ABSTRACT OF THE EXPENSES OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS FOR THE PAST THREE YEARS, 1887-8-9.

ITEM.	1887.	1888.	1889.	Total.
1. Interest on mortgage	$800.00	$800.00	$800.00	$2,400.00
2. Taxes	471.15	483.83	425.75	1,380 73
3. Publications	8,069.30	10.508.85	12,734.64	31.312.79
4 Stationary and printing	970.90	1,233.82	1,297.51	3,502.23
5. Postage	1,355.43	1,543.85	1,902.23	4,801.51
6. Library	797.37	814.05	957.18	2.568.60
7. Salaries	3,000.00	3,000.00	3,000.00	9,000.00
8. Convention and An. Meeting	1,597.95	1,417.27	1,093.23	4,108.45
9. Janitor, house supplies, fuel, water and gas	1,867.78	1,724.22	1,279.47	4.871.47
10. Certificates of membership	58.25	138.45	96.50	293.20
11. Insurance	244.63	71.88	54.62	371.13
12. Medals and prizes	120.50	120.50	120.60	361.60
13. Finance, treasurer's books, general accts, collections	1,100.00	1,200.00	1,200.00	3,500.00
14. Work of Committees	370.00	467.00	876.57	1,713.57
15. Other expenses	441.23	418.23	433.16	1,292.62
Totals	$21,264.49	$23,941.95	$26,271.46	$71,477.90
Pages of publications	875	799	1,074	2,748
No. of inset plates	67	138	143	348
No. of members at beginning and end of year, and average	1,019 1,110 1,065	1,110 1,243 1,176	1,243 1,335 1,289	1,177

TABLE 3.

ABSTRACT OF THE EXPENSES OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS FOR THE PAST THREE YEARS, ENDING NOV. 1, 1888, 1889, 1890.

ITEM.	1888.	1889.	1890.	Totals.
1. General printing and stationery	$813.73	$1,196.84	$1,617.71	$3.628.28
2. Reprints and publications	2,739.33	3,520.80	4,761.15	11,021.28
3. Postage	378.10	768.41	635.59	1,782.10
4. Library	125.06	248.00	164.55	537.55
5. Salaries	2,658.27	3,163.58	3,913.25	9,735.10
6. Office expenses	206.99	368.71	429 42	1,005.12
7. Engraving	1,003.92	843.69	1,057.30	2,904.51
8. Binding	.....	440 50	470.70	911.00
9. Meetings	941.03	748.55	1,041.75	2,731.33
10. House furniture	80.24	487.15	686.89	1,254 28
11. Badges	400.50	576.00	695.25	1,671.75
12. Traveling	171.90	134.15	38.00	344.05
13. Rent	687.50	907 50	1,592.31	3,277.31
14. Work of committees	.....	27.50	167.72	195.22
15. Contingencies	.....	10.00	61 25	71 25
Totals	$10,279.26	$13.531.18	$17,332.84	$41,143.28
Pages of public't'ns	753	1,032	1,195	3,080
No. of inset plates	not counted		about	50
No. of members at beginning and end of year and average	813 903 863	903 1,049 976	1,049 1,242 1,146	995

An error of some $70 in some item of the first column, due to some misprint, has not been investigated and corrected.

TABLE 4.

COMPARATIVE STATEMENT OF THE AGGREGATE EXPENSES FOR THE PAST THREE YEARS OF THREE ENGINEERING SOCIETIES IN COMPARABLE ITEMS.

[Certain items special to particular societies deducted from their totals, as specified below. Figures in [brackets] refer to the corresponding items in the separate tables.]

	Am. Inst. Min'g Eng'rs.	Am. Soc. Civil Eng'rs.	Am. Soc. Mech. Eng'rs
Av. membership	1,740	1.177	995
Total pages published	2,791	2,748	3,080
Do. plates do.	30	348	.....
ITEMS OF EXPENSE.			
1. Publication	$15,184.48	$24,352.79	$11,021.28
2. Engravings	3,978.40	6,960.00*	2,904 51
3. Stat'y and printing	1,013.07	3,502.23	3,628.28
4. Postage	3,859.57	4,801.51	1,782 10
5. Library	294.70	2,568.60	537.55
6. Salaries	18,083.20	12,500.00	9,735.10
7. General meetings	1,912.38	4,108.45	3,075.38
8. Rental charges	2,400.00	4,151.86	3,277.31
9. Maintain'g quarters.	560.67	4,871.47	1,005.12
10. Work committees	.....	1,713.57	195.22
11. Miscel.	301.28	1,292.62	71.25
Total of comparable items.	$47,587.73	$70,823.10	$37,296.25
Non-comparable or special items not included.	General index, binding, fitting up new room [4, 8, 9, '10, 21, 26] $6,258.38.	Medals and prizes, certificates of membership [10, 12] $654.80.	Furniture, badges, binding [5, 10, 11] $3,837.03.
Total of all expenses, 3 years	$53,846.11	$71.477.90	$41,133.28

ITEMS OF THE ORIGINAL ACCOUNTS (TABLES 1, 2, 3) COMBINED TO MAKE THE ITEMS OF THE ABOVE TABLE.

ITEMS ABOVE.	Am. Inst. M.E. Table 1.	Am. Soc. C. E. Table 2.	Am. Soc. C.E. Table 3.
1	1, 2, 3, 14, 18, 20, 22	3	2
2	12		7
3	5, 6, 7	4	1
4	13, 14	5	3
5	11	6	4
6	28	7, 13	5
7	29	8	9, 12
8	16	1, 2, 11	13
9	17, 23, 24	9	6
10	.....	14	14
11	19, 25, 27	15	15

* Cost of plates in Am. Soc. C. E. publications estimated at $20 each, and deducted from the "Publication" account, which in the Am. Soc. C. E. includes engravings. A small error in the footings of the Am. Soc. M. E., due to some misprint, remains uncorrected.

The Financial Management of Three Engineering Societies.

We exhibit in the accompanying tables:

First, in Tables 1, 2, 3, across the top of the page, the expenditures of the three leading engineering societies, in form and order as returned in the reports of their respective treasurers, for each of the last three years separately, and in the total for the three years. The three societies are:

1. THE AMERICAN INSTITUTE OF MINING ENGINEERS, organized in 1871, and now numbering 1,968 members of all classes, with $10 yearly dues.
2. THE AMERICAN SOCIETY OF CIVIL ENGINEERS, organized in 1852-1867, and now numbering 1,335 members of all classes, with $15 to $25 yearly dues.
3. THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, organized in 1880, and now numbering 1,242 members of all classes, with $15 yearly dues.

Secondly, in Table 4, we give a summary under 11 common items of the comparable expenditures of the three societies, omitting from the totals of each certain items which are peculiar to itself, and do not exist in the other two societies. Thus, the Am. Soc. C. E. alone has any medals or prizes; the Am. Soc. M. E. and the Am. Inst. M. E. have had in these years large expenditures for a general index, for fitting up new quarters (at the expense of the general fund), and for binding, etc. These incomparable items, thus omitted from Table 4, are specified in detail at the bottom of that table.

Thirdly, in Table 5 is given an abstract from Table 4, showing the total expenses per member for the three years, the average number of members being determined by (1) averaging the number at the beginning and end of each year for the yearly average, and (2) averaging the three yearly averages for the final mean.

Moreover, to make the expenses per member fairly comparable in the important item of publications, some further correction is necessary, because of the difference in total number of pages published. This

TABLE 5.

COMPARATIVE EXPENSES PER MEMBER OF THREE ENGINEERING SOCIETIES FOR THE PAST THREE YEARS IN COMPARABLE ITEMS.

	Am. Inst. M'n'g Eng'rs	Am. Soc. Civ. Eng'rs.	Am. Soc. Mech. Eng'rs
Av. membership	1,740	1,177	995
Total pages pub.	2,791	2,748	3,080
Do. plates do.	30	348	50
1. Publications	$ 8.73	$20 69	$11.08
2. Engravings	2.29 $11.02	5.91 $26.60	2.92 $14.00
3. Stat'y and p't'g	0.58	2.97	3.64
4. Postage	2.22	4.08	1.79
5. Library	0.17	2.19	0 54
6. Salaries	10.39	10.62	9.78
7. Gen'l meetings	1.10	3.49	3.09
8. Rental charges	1.38	3.53	3.30
9. Maint. quarters	0.32	4.14	1.01
10. Work of com's	.....	1.45	0.20
11. Other expenses	0.17	1.10	0.07
Total per member of comparable items	$27.35	$60.17	$37.48
Add to total cost of publications to equalize pages of publications and engraving at rate of 1 plate = 4 pages	42⅝, = $4.63	.....	34.38, =$4.80
Total expenses in comparable items, equalized for an equal total of publications	$31.98	$60.17	$42.28

The Am. Soc. M. E. footing is not correct within 6 cents, due to some undetected misprint in the original records.

further correction is also made, on as fair a basis as we know how to adopt, at the foot of Table 5.

These tables will be examined with interest by members of all three of the societies in question, as enabling them to judge how much is being accomplished by each with the means at command; but they will be of especial interest to members of the American Society of Civil Engineers at this juncture, in view of the approaching election. That election means practically either a change in or continuance of the present management. The real pending issue is: Has the recent management and policy of that Society been reasonably vigilant, progressive and economical, and should it be continued in substantially the same hands; or, Has it fallen short in any or all of these respects, and is a change desirable?

The financial management, as indicated by results obtained from given expenditures, is only one of several elements to be considered in answering this question, but it is an important element. In regard to it, we present herewith only the bald facts without other comment than is essential for clearness, leaving it to each reader to interpret the facts as he likes. It might also be desirable to give certain general facts other than financial, as to the organization and policy of each society, but this we must do, if at all, in a following issue. In the meantime, the main facts from these tables may be summarized thus:

Total Expenses.—Omitting the non-comparable items in each society for expenses peculiar to itself, the total spent in the last *three* years for 11 comparable items (Tables 4 and 5) has been as follows:

Total Expenses in Comparable Items, for Three Years.

	Av. No. members.	Amount.	Per member.
Am. Inst. M. E.	1,740	$47,588	$27.35
Am. Soc. C. E.	1,177	70,823	60.17
Am. Soc. M. E.	995	37,296	37.48

The expenditures for Items 8 and 9, "Rental charges" and "Maintenance of quarters" are not strictly comparable, only the Am. Soc. C. E. having had a whole house for this period. The Am. Soc. M. E. has purchased a very large and fine house during the past year, but previously had office quarters only, as has the Am. Inst. M. E. The Am. Soc. C. E. has semi-monthly meetings at its rooms also, which the other two societies do not have. On the other hand, the Am. Soc. C. E. has a fund of about $20,000 invested in its building, the interest on which should properly be added for comparative purposes, but is not, to the total of Item 8. Deducting Items 8 and 9, the comparison stands as follows:

Total Expenses other than for Quarters, for Three Years

	Av. No. members.	Amount.	Per member.
Am. Inst. M. E.	1,740	$44,627	$25.65
Am. Soc. C. E.	1,177	61,800	52.50
Am. Soc. M. E.	995	33,014	33.17

The total expenses *for* quarters and maintenance thereof, for the past three years, which was deducted from the first given total to give this summary, stands as follows, adding to the Am. Soc. C. E. $1,000 per year, or $3,000 in all, for interest on its building fund:

Expenses for Quarters and Maintenance Thereof, Three Years.

	Av. No. members.	Amount.	Per member.
Am. Inst. M. E.	1,740	$2,961	$1.70
Am. Soc. C. E.	1,177	12,023	10.22
Am. Soc. M. E.	995	4,282	4.31

Publications and Engravings.—These items are not given separately in the Am. Soc. C. E. reports, but in aggregate only. We have divided that aggregate in two as accurately as possible, in Tables 4 and 5, as explained in those tables, but such sub division can be at best only approximate. On the other hand, in the Am. Inst. M. E., the "Publications" item is itself subdivided under seven different heads. The total pages published by the three societies differs remarkably little, the Am. Soc. C. E. being slightly the smallest of the three, and the Am. Soc. M. E. the largest; but on the other hand, there is an important difference in respect to number of inserted plates, which makes in favor of the Am. Soc. C. E. While the other societies have very few of these plates, but prefer instead to work their engravings into their pages, the Am. Soc. C. E. has a great many inset plates, chiefly lithographs and not expensive, however, and inserted without much visible effort to maintain a common or a high artistic standard, or to reduce the number of plates by getting as much as possible on each. In real technical value to the members of the respective societies their publications for the last three years appear to us to make a remarkably close approach to each other, at least, both in quantity and quality. Their total cost stands as follows:

Total Cost of Publications for Three Years.

	Av. members.	Pages pub.	Plates.	Amount.	Per member.
Am. Inst. M. E.	1,740	2,791	30	$19,163	$11.02
Am. Soc. C. E.	1,177	2,748	348	31,313	26.60
Am. Soc. M. E.	995	3,080	50	13,926	14 00

Calling one plate as equal in cost to four pages of text, in order to make a fair comparison on the basis of equal volume of publications, we must increase the expenses of the Am. Inst. M. E. 42 %, and of the Am. Soc. M. E. 34.3%, in order to compare on this basis with the Am. Soc. C. E. Making this correction, as shown in Table 5, we have:

Equated Cost of Publications, for an Equal Total of Published Matter.

	Average members.	Equated pages.	Cost.	Per member.
Am. Inst. M. E.	1,740	4,140	$27,211	$15.65
Am. Soc. C. E.	1,177	4,140	31,313	26.60
Am. Soc. M. E.	995	4,140	18,703	18.80

The cost per member ought, other things being equal, to decidedly decrease with number of members, so that the Am. Soc. M. E. is at somewhat of a disadvantage and the Am. Inst. M. E. at somewhat of an advantage in comparing publication expenses per member.

Deducting all expenses for both publications and quarters (Items 1, 2, 8 and 9 of Tables 4 and 5) the remaining comparable expenditures af the three societies for the past three years, being those for stationery and printing, postage, library, salaries, meetings, work of committees and miscellaneous, compare as follows:

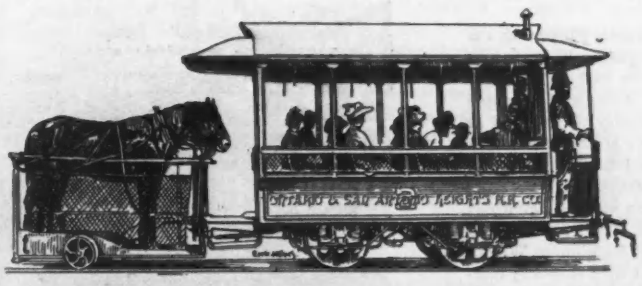
Expenses other than for Publications and Quarters, total for Three Years.

	Average members.	Amount	Per member.
Am. Inst. M. E.	1,740	$25,464	$14.63
Am. Soc. C. E.	1,177	30,487	25.90
Am. Soc. M. E.	995	19,088	19.17

In regard to this summary it is proper to state that no one of these societies makes a practice of purchasing books for increasing its library, nor binds up more than a few of its current periodical publications, but the Am. Soc. C. E. has much the largest library of the three, which of course requires so much more attention. The mining engineers hold four general meetings yearly, the civils two, the mechanicals two to three.

Mixed Methods in Street-Car Propulsion.

Ontario, Cal., is the scene of an interesting departure in street railway practice, as illustrated in our cut made from a photograph kindly sent us by Mr. F. E. Trask,



C. E. The railway is laid out on the principal avenue of the town and is 6 miles in length, with a total rise of 1,000 ft. in this distance. The grade varies from 1% at the lower end, to 8% at the upper end.

The line was projected as an electrical road; but at the time the photograph was taken it was operated by animal power on the up trip and by gravity down the hill. The cars can be started by gravity at any point on the descending trip, and strong brakes control them.

The cut represents the car coming down the incline with the animals aboard of it. When the foot of the hill is reached the sides of the car holding the horses are folded down upon the bed and this auxiliary car is then run under the passenger coach and its two wheels raised clear of the track. Mr. Trask does not know who originated this scheme, but says that two mechanics of Ontario developed the idea to its present stage of utility and economy. The trip is made quicker than when horses were used for both directions.

Track Details, Third Ave. Cable Railway.

WITH INSET.

While complete drawings of the Third Ave. cable road plant in New York have not yet been made public, we are enabled to give the following details of the track construction through the kindness of Mr. A. H. Lighthall, chief engineer of the road. The contractors for the work are Wm. Wharton, Jr. & Co., of Philadelphia, whose reputation is a guarantee for thorough construction.

The arrangement of conduits and yokes is shown in Figs. 1 and 2. The cast iron yokes are 4 ft. apart and rest on a block of Portland cement concrete 5 × 1 × 1 ft. They are made in one piece, and not composite, as was at first intended. They carry heavy 83-lb. girder rails, illustrated in Engineering News of Aug. 9, and a special slot rail consisting of two strongly braced sections, shown in the cuts. This rail is bolted to the yoke and attached to the girder rails by a series of alternating heavy castings, shown in elevation in Fig. 1, and lighter braces, indicated by the dotted lines in Fig. 3. This construction will, it is hoped, produce a much stiffer track than usual.

The cable conduit, Figs. 2 and 3, consists of a Portland cement concrete monolith, 8 ins. thick at the sides and 10 ins. at the bottom. Running under the whole roadbed is a 6-in. bed of Rosendale cement concrete, covered with 2 ins. of sand on which the paving rests. A small iron pipe, *A*, Fig. 1, is laid in this Rosendale concrete between the two tracks. Through this pipe, which is supplied with doors at short intervals, the car conductors can communicate with the nearest power station in case of accident. The doors are locked, in order that there may be no malicious interference by outsiders, each car being supplied with a key.

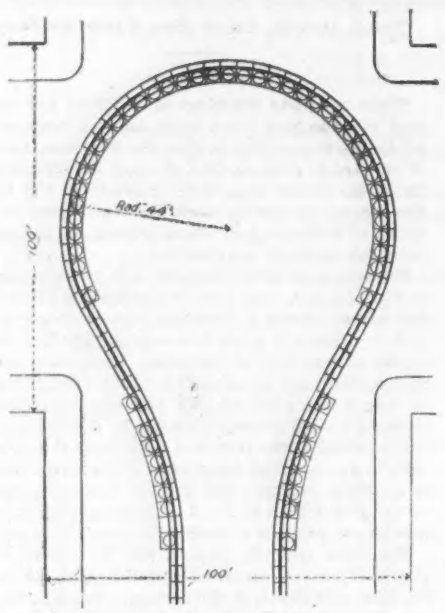
The manner of connecting the girder and slot rails by braces gives an easy method of keeping the track in alignments. Between the corresponding surfaces a layer of cement is forced, which, on setting, gives a firm connection between the parts.

The slot rail switch is shown in Figs. 4-8. It consists simply of a 1-in. steel tongue pivoted at one end and swinging at the other over the slot to be closed, like a point switch on a railway track. The intersection of the two conduits is made by means of special yokes, which are clearly shown in the cuts and require no explanation. A heavy 1-in. steel plate acts as a bracket to support the hinge of the tongue, and all parts of the switch are very strong and solid.

Special attention has been paid to the draining of the conduits, and the pulley vaults, Figs. 9-12, are arranged in such a manner that all water entering the conduits cannot touch the cables or wheels at any point. The vaults are usually connected with the sewers by manholes, those vaults which are without such a connection being drained into a neighboring vault with such a shaft. These vaults are entered through large man holes between the tracks.

The wheels are carried in special chambers at each side of the vault, as shown in Fig. 11. Between these chambers and the vault is a concrete arch shown in Fig. 12. The conduit is cut away at the bottom just before entering the chamber, as shown in Fig. 12, and all water is thus carried off from the wheels, doing away with any danger of rust from this cause.

The whole line will be divided into three sections, operated from two power stations, the larger of which will be located at 65th St. and 3d Ave. The site for the second has not yet been chosen, but will probably be in the neighborhood of Grand St. One of the most interesting features of the track, is shown in Fig. 13. This is the loop at the Post Office terminus of the line. The radius of curvature is only 41 ft. and the details of the sheaves and other appliances are entirely original with Mr. Lighthall. As affording an interesting comparison with the proposed loop, we give a cut, taken from the *Street Railway Journal*, of a similar terminus in Denver, Colo. The radius of this loop is 44 ft. It was found that all sheaves would not turn owing to the total pressure of the cable against some of them being insufficient. When 6 of the sheaves were



Loop in Cable Road, Denver, Colo.

omitted, however, no difficulty was experienced and cars are occasionally run around the curve at a speed of 9 miles an hour. Next week we will give drawings of the pulleys and cable lifting apparatus.

American Nickel Steel.

At the Homestead Steel Works, an apparently successful attempt was recently made to produce nickel steel of a quality equal to that in the Le Creusot armor plate used in the Annapolis tests a short time ago. The experiment was on a quite large scale, a 5-ton blow being produced in a Bessemer converter. Part of the metal was rolled into a ¾-in plate, which was cut into test specimens.

Two of these pieces were tested Dec. 5. The elastic limit was 59,000 and 60,000 lbs., and the ultimate tensile strength, 100,000 and 102,000 lbs. respectively, somewhat below the figures given in Howe's "Metallurgy" for the same amounts of nickel, viz., 3.16%. The elongation on fracture was 15½ %, and the reduction of area 29½ and 26½ % respectively, both considerably in excess of the figures given in the above-mentioned work.

As some recent German experiments show that this metal resists corrosion and fouling better than ordinary steel, Secretary TRACY has directed that some of the plates made by Carnegie, Phipps & Co. be submerged, together with some ordinary steel plates, so that these qualities of the metal can be tested.

Within the next 90 days Carnegie, Phipps & Co expect to deliver to the Navy Department their first test armor plates, of which some will be all steel and others nickel steel. These plates will be tested in comparison with the two French plates fired at in the recent armor trials. Their armor-plate plant is now complete, with the exception of erecting the large cranes for handling the plates, the hydraulic press for shaping them, and some special machines for trimming and finishing them. Their process will differ from that adopted by the Bethlehem Works in that the plates will be rolled in a specially constructed mill of great power instead of being forged. They expect to begin the delivery of armor under their contract by or before next June. The Bethlehem Co. will not be ready so soon owing to delay in getting its 125-ton hammer set up.

Subway Construction, as Proposed for the Metropolitan Underground Railway of Paris.

The subject of rapid transit in Paris is again under discussion, and French engineers are studying the means of execution in the more crowded streets. The last number of *Le Genie Civil* contains a series of sketches here reproduced, that have some interest to New York readers in connection with the relief of underground Broadway.

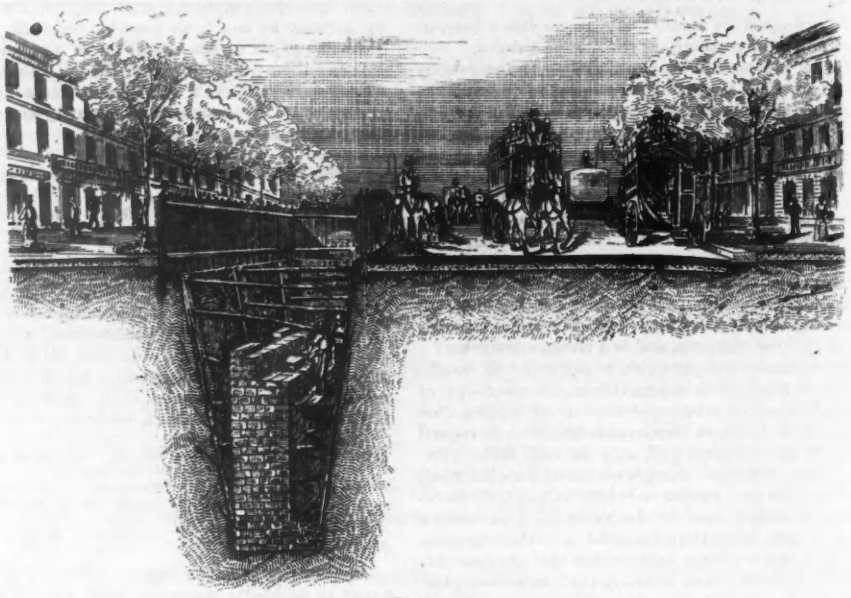


FIG. 1.

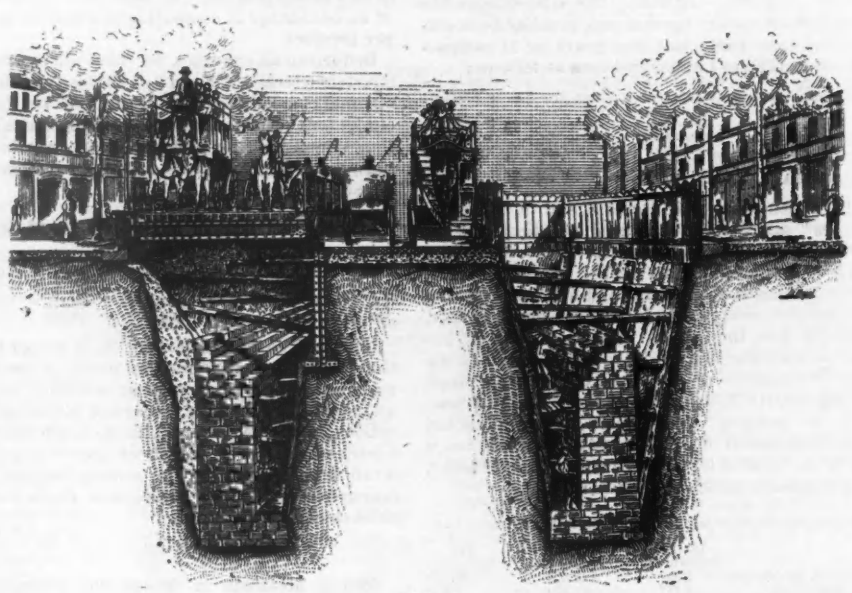


FIG. 2.

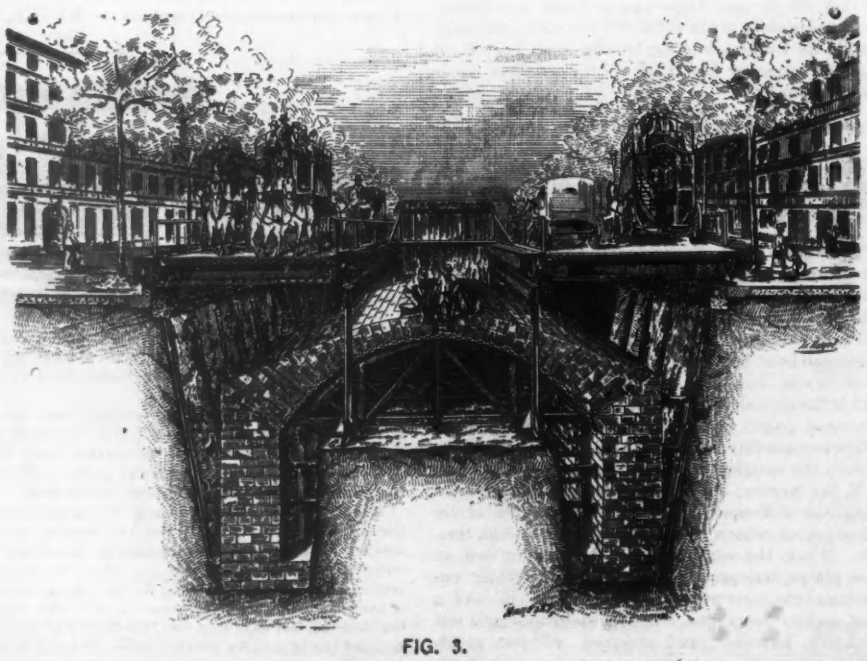


FIG. 3.

PROPOSED SUBWAY CONSTRUCTION IN PARIS.

The sketches practically explain themselves, the chief end in view being the building of the necessary underground work with as little obstruction to surface traffic as possible. This method assumes that the subsoil is sufficiently stable for the foundation, or that it can at least be piled, and that there will be no immediate danger from lateral movement. The work would then proceed in five distinct stages, continuously carried out as follows:

(1) Construct in an excavated pit one of the side walls, with proper footing and the skewback for the arch (Fig. 1). (2) On tracks, supported by the curb

FIG. 4. PROPOSED SUBWAY CONSTRUCTION IN PARIS.

on one side and on columns on the other, place a rolling bridge of iron, restoring the traffic over that portion of the street, then build the other side wall (Fig. 2). (3) Provide a second bridge for traffic, remove the center third of the roadway and the soil under it to a point low enough to fix arch centers. Then build the arch (Fig. 3). (4) Fill over the arch and restore the street surface; then excavate the core below the arch and (5) construct the inverted arch (Fig. 4).

The Construction and Maintenance of Track.

The following notes are taken from the paper by Mr. J. A. HALL, M. Am. Soc. C. E., presented at the meeting of the American Society of Civil Engineers, Dec. 3.

The width at subgrade for single track roads of standard gauge should be not less than 14 ft. on fills and 18 ft. in cuts; in cross section the center should be 8 ins. higher than the sides. The slopes of cuts should in general be 1 to 1, as it is cheaper to take out the earth to this slope while grading the road than to alter the slope afterwards. On the top of the cut, on its higher side, should be a ditch 3 ft. from the edge, the earth being thrown out to form a bank on the side next the cut. Pipe drains, laid with open joints, may be used for wet cuts. The better form of cattle guard is that without a pit, as it is less dangerous in case of a derailment; a good form of surface guard is the National cattle guard [described and illustrated in ENGINEERING NEWS, Aug. 31, 1889.—ED. ENG. NEWS]. A good form of fence is of barbed wire, with cedar posts 12 ft. apart the fence should be 5 ft. high, with 5 wires, or 4 wires and a top plank spiked to the posts; the two lower wires should be 6 ins. apart.

In regard to ties, the growing of suitable timber should be encouraged, as creosoted timber is so much cheaper than metal for ties. White and post oak are the best timbers. Chestnut or other soft woods are not desirable unless metal tie-plates are placed under the rails; the Servis and "shoulder" tie-plates were mentioned. [See ENGINEERING NEWS, March 16, 1889, and April 26, 1890.—ED. ENG. NEWS.] The cutting of the tie by the rails forms a receptacle for water and starts rot. Hewed ties are preferable to sawed ties, and their life is a third longer. The ends should be sawed square. Ties should have a uniform length of 8 ft., and a variation of only 1 in. allowed in the length; they should be of uniform thickness and have a face 8 to 10 ins. wide. Tie inspectors should be directed to rigidly enforce the regulations as to dimensions. The use of second class ties is not to be recommended. Ties should be seasoned in storehouses for one year before being used; if they are to be treated by any preservative process the spike holes should first be bored, so as to thoroughly treat all surfaces, and the spikes hold better when driven into holes. The spike holes should be about $\frac{1}{16}$ in. smaller than the spike, and about $\frac{1}{4}$ in. shorter. [In England, where the holes for spikes and trenails are always bored, the holes are generally bored right through the tie.—ED. ENG. NEWS.] Ties should be spaced not more than 2 ft. c. to c. The joints and centers of rails should be spiked first. It is bad practice to fill old spike holes with wooden plugs; sand filling gives better results. The ordinary track spike is $5\frac{1}{2}$ ins. long, $\frac{9}{16}$ in. square, and weighs $\frac{1}{3}$ lb.; the "curved safety" spike he considered preferable to the ordinary straight spike, although more expensive, as being better made and giving a more secure hold. [In view of the results of experiments made with various forms of spikes, it seems probable that the good hold is due more to the better manufacture than to the curved form of the spike, and that careful tests would not show any superiority of the curved over straight spikes of equally good make.—ED. ENG. NEWS.] Rail braces should be used on all curves over 6°, and not less than 3 braces to the rail.

Mr. HALL approved the form of rail recommended by the Society's committee. The 70-lb. standard rail of the Richmond & Danville R. R. is $4\frac{3}{4}$ ins. wide, $4\frac{3}{4}$ ins. high, head $2\frac{7}{16}$ ins. wide and $1\frac{1}{2}$ ins. deep, with a top radius of 12 ins. and top corners of $\frac{1}{4}$ in. radius; the web is $\frac{1}{2}$ in. thick in the middle, with sides of 12 ins. radius; fishing angle of head, 12°. The angle splice bars used with this rail have the edges of the flanges turned down to be level with the bottom of the rail. Rail cars should be used in handling rails. Rails should have the ends sawed and filed, and should be curved for all curves up to 10°. Rail benders are not satisfactory as they do not bend to an even, uniform curve, and rails should never be bent by dropping them on a pile of ties. Mitred rail ends have given good results. [This plan has been tried several times, but has shown no special advantages in practice, and is based on an incorrect theory, as it is not the gap in the rail which causes the jar to the wheels.—ED. ENG. NEWS.] In regard to joints, he believed supported joints, with rails laid to break joints, to be the best arrangement. He approved of the Fisher bridge joint, but thought that its disadvantages are the cutting or lowering of the joint ties for the bridge plate, and the necessity for the use of longer spikes through this plate. Of nut-locks he instanced the Stark, which has a spring key fitting in a keyway in the nut and bolt, and the National spring washer nut lock. Transition or easement curves should be used, and as no trackman's eye can be relied on for laying out curves, iron plugs should be put in for permanent centers. On curves it is better to elevate the outer than to depress the inner rail. Foremen should ride over their divisions on ordinary trains to observe the effect of the curves on the train.

Broken stone is the best material for ballast, and should be about 2 ins. in size; gravel, being round, does not hold the track in line as well as sharp broken stone; sand does not hold well, and earth should never be used. As tamping cannot be done in winter, shimming must be resorted to in bringing track to proper surface; shims should be not more than 2 ins. thick, and where more than this is required a piece of 1-in. plank should first be spiked to the top of the tie. The shims must be removed in the spring. Ties should be adzed only in extreme cases. Great care should be taken in selecting ties requiring renewal, and in renewing them the bed of the old ties should be disturbed as little as possible. The ties should not be moved by striking them with a pick, as this leaves a hole for the water to enter. In raising track, both rails should be raised together, and jacks should be used instead of levers; the friction jack is preferable to the ratchet jack. The ties must not be tamped too hard at the middle. Places where track is heaved by frost should not be disturbed in winter, but marked with paint and thoroughly dug up in the spring. Split or Lorenz switches and stiff-keyed frogs are best for yards, and the Wharton switch and spring rail frog for main track. An arrangement of side tracks for a single track road was suggested (Fig. 1), which affords good facilities and safety in handling trains; the side tracks overlap, so that two freight trains can pass each other, and the operator's cabin is located near the middle switches, so that he has good control over the whole arrangement.

The author coincided with the belief of the late Mr. CHARLES LATIMER, that Sunday work should be avoided, and that it could easily be avoided with good management. It is very desirable to have a good class of trackmen and foremen; they should be treated well and kindly, as such treatment keeps the men contented and in good humor, and under

Fig. 1. Arrangement of Side Tracks on a Single-Track Railway.

such circumstances they do much better work than when roughly treated. The habit of swearing at the men should be discouraged. The foremen especially should be men of intelligence, and should themselves work on the track instead of standing around to watch their men. The premium system results in better work being done and more interest taken in the work.

An early motion for the adjournment of the meeting rather curtailed what might have been an interesting discussion on the methods of practice, as several members differed with the author on various points. It was said to be the better practice to elevate and depress the inner and outer rails on curves to an equal amount; the highest elevation should be 4 ins. on a 6° curve, and if this is not sufficient for the speed of trains, the speed should be reduced. Mr. R. L. HARRIS remarked that as slopes would vary in different material, it was not wise to recommend a general slope of 1 to 1, and in some materials a ditch 3 ft. from the edge of a cut would cause the edge to split off.

THE U. S. PATENT OFFICE, in the fiscal year 1889-90, issued 25,857 patents and 1,636 trade marks and labels. In this period 11,885 patents expired. There were 46,140 applications, including trade marks, etc. The total receipts of the department were $1,347,203, and the total expenditures were $1,081,173. The surplus of $266,029 was turned into the Treasury, and swells the total credit to the patent fund to $3,790,556.

Commerce on the Lakes.

The commerce on the Lakes for the present year surpasses in volume any previous record. The Cleveland correspondent of the New York *Herald* says this commerce is now more than one-half greater than the combined foreign and coastwise shipping of the great English ports of Liverpool and London. More tons of freight pass through the Detroit river in a year than the total imports and exports of the United States in the same time, and in 234 days of 1889 there were locked through the "Soo" Canal more tons of freight than passed through the Suez Canal in a whole year.

The Lake Superior iron regions shipped 7,500,000 tons of ore last year as compared with 4,700,000 tons in 1887, and the return for this year will be 8,500,000 tons. To accommodate this immense traffic there are 16 miles of docks at the Lake Erie ports of Cleveland, Ashtabula, Fairport, Buffalo, Erie, Sandusky, Toledo and Lorain. Of these docks 55% are occupied by the ore trade and the remainder by coal. The ore docks average 180 ft. deep and cover 10,000,000 sq. ft. of dock space, and they can handle 90,000 tons of ore daily and store about 6,500,000 tons. They are so equipped with steam hoisting apparatus and loading chutes that 2,500 tons of ore have been put on a vessel in two hours. The best unloading record is 2,600 tons in seven hours.

The seven miles of coal docks at the Lake Erie ports can handle 75,000 tons per day. The grain trade is chiefly between Chicago, West Superior, Duluth and Milwaukee on the West, and Buffalo on the East. Last season these ports shipped 34,887,000 bushels of wheat alone to Buffalo. The total corn tonnage was still greater and the flour transfer amounted to 3,850,000 barrels.

Ten years ago there were few 2,000 ton vessels in the trade; to-day there are dozens afloat that can carry 2,500 tons on 15½ ft. draught, and could carry 3,000 tons with the channels deepened to 18 ft. The load records show that the steel steamer *Maryland* carried 3,640 net tons of ore on a draught of 16 ft. Many of these new steel steamers develop a speed of 15 miles per hour, on a spurt; and the *Owego* has made the round trip from Chicago to Buffalo at the average rate of 15 miles per hour, going up light and coming back with 85,000 bushels of corn.

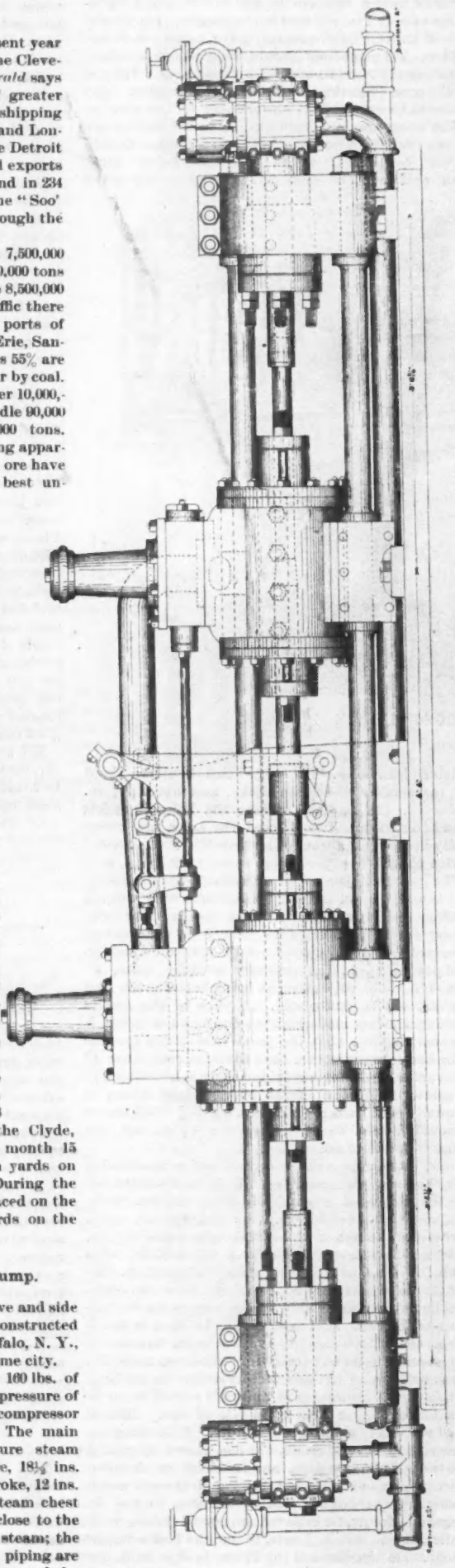
In 1887 the new tonnage built on the Lakes aggregated about 100,000 tons; last year vessels of a carrying capacity of 90,000 tons were launched, and this year the totals will reach 100,000 tons, and the contracts for 1891 promise as much. More than one-half of this new tonnage is steel, and four-fifths of it is steam. This ship building record compares favorably with that of the Clyde. During July last 18 steamers of all classes were launched on the Clyde, aggregating 15,668 tons. In the same month 15 steamers were put afloat from American yards on the Lakes, aggregating 17,668 tons. During the same month orders for 8,000 tons were p'aced on the Clyde, and 18,000 tons at American yards on the Lakes.

Compound Duplex Hydraulic Pump.

The pump here illustrated, in perspective and side elevation, was especially designed and constructed by the Buffalo Steam Pump Co., of Buffalo, N. Y., for the Lake Erie Boiler Works, of the same city.

It is to be used with a boiler carrying 160 lbs. of steam and is designed to work against a pressure of 2,000 lbs. per square inch in the hydraulic compressor used by the firm named in riveting. The main features of the pump are high-pressure steam cylinders, 12 ins. diameter; low-pressure, 18½ ins. diameter; plungers, 3½ ins. diameter; stroke, 12 ins.

Each steam valve is balanced. The steam chest of the high-pressure cylinder is placed close to the steam cylinder for the purpose of saving steam; the valve chambers of the pump and the piping are made of brass; the bearings are extra large and the wearing parts adjustable wherever possible. The pump has been in use for some time and is said to be doing excellent service, with a large saving in steam due to the adaptation of the compound principle as here applied.



COMPOUND DUPLEX HYDRAULIC PUMP; SIDE ELEVATION.

Road Work in Richmond County, New York.

The Board of Supervisors of Richmond County (Staten Island), New York State, have entered upon an extensive system of road improvement, a commencement upon which has been made during the season just closing.

Under the direction of Mr. WILLIAM S. BACOT, Engineer of County Roads (to whom we are indebted for much of the following information), surveys have been made for some 67 miles, and contracts have been let for 30 miles, as noted in ENGINEERING NEWS, Nov. 29. Work upon these contracts will be commenced in the spring, and it is expected that the entire 30 miles of roads will be completed at the close of the summer months of next year. What will be done with the remaining 37 miles of roads remains to be seen. The principal work of this year, which was commenced early in November, has been the repairing of the Shore Road, known as Richmond Terrace, on the north side of the Island, extending from St. George to Port Richmond, a distance of 3 miles, and the construction of a telford roadway for a distance of 1½ miles, having a width of 16 ft., on the Morning Star Road, which traverses the western end of the county. P. Hart & Son, of New Brighton, S. I., have the contract for the former; the steam roller used by the contractor is a Harrisburg machine, weighing about 10 tons. Denis Donovan, of Port Richmond, S. I., is the contractor for the latter section, and uses a new Aveling & Porter (English) roller, also weighing 10 tons.

Repairs are conducted as follows: The old macadam roadbed is first picked up by the steam roller equipped with 4-in. spikes for that purpose. The roadway is then covered with 2½-in. broken stone and made to conform to the established grade and curvature of the road. The new layer, together with the old stone of the roadbed is required to make a total depth of 8 ins. Immediately after this the broken stone is rolled in dry condition until the roller causes little or no motion among the seperate fragments; the binding material is then applied in a thin layer, generally not over ½ in., and rolled in dry until the whole mass is sufficiently compact to bear the weight of heavy wagons without making much impression. The application of water sprinkled from a cart begins the finishing process in which the roller is kept constantly at work, generally following the sprinkler; more binding material is applied here and there according to the judgment of the engineer in charge, and toward the close of the work another ½-in. finishing layer of binding material is applied and rolled in, a portion of which generally remains on the top to be ground up and rolled in by the traffic. Watering and rolling are continued until the bed is sufficiently filled up with the binder to cause the water to puddle on the surface. A period of about 48 hours is allowed to elapse before the road is thrown open to the traffic to allow for the setting of the materials. The same process as that above outlined for repairs will be followed in building the new macadam and telford roads, so far as it applies. The macadam pavements are to be laid in two courses for both 6 and 8-in. roads; the usual pitched bottoming, rolled to place, is laid in the case of telford roads, being 8 ins. deep, with a 4-in. finishing top course of 2½-in. stone, laid and finished as above specified and aggregating 12 ins. in thickness. The widths of the country roads are 16 and 14 ft., about equally divided, while some are full width of roadway, 20 to 25 ft. The character of the subsoil of Staten Island is well adapted for macadam roads in sections where good natural drainage is possible, though in many localities the flat nature of the ground renders sub-drainage of one kind or another indispensable. The volume and character of the traffic on several of the main thoroughfares is such as to require pavements of a special kind; for these telford is provided in most cases; in others 8-in. macadam is substituted.

The stone used for repairs, new macadam and the top course of telford pavements is trap rock only

and the binding material consists of dust and screenings of the same material. It is obtained for the present contracts from quarries on the island. The ridge on which they are located is a continuation of the Palisade backbone, which traverses Bergen Neck, and passing under the Kill von Kull crops out at Port Richmond and extends southward to or near Freshkills. The crushed stone and screenings cost about $1.65 per cu. yd., delivered on the work. The bottoming stone for telford work costs from 80 to 90 cts., delivered. The macadam stone is machine broken, and has, therefore, as we observed on visiting the work, the disadvantage of containing a considerable proportion of flat pieces, instead of the cubical pieces which are the best form for road work. In some parts of England (as in Gloucestershire, where we inspected some country roads last summer) machine broken stone is not allowed for this reason, all the stone being broken by hand labor. The first cost of the hand-broken stone is of course much greater, although the stone is more economical in requiring less repairs. No other but machine-broken stone can, however, be obtained here at the prices at which contracts are made, but it is to be wished that some machine could be put on the market which would break the stone to the more desirable cubical form.

The roads have to be built to be suitable for heavy teaming and for light driving, and it is rather difficult to have a system of construction combining the best methods for both these classes of traffic. Some of the heaviest traffic consists of loaded four-wheel beer wagons, weighing eight tons. The tires of the wheels for these wagons are sometimes only 2½ ins. wide, but it is proposed to pass an ordinance regulating the widths of wheel tires in accordance with the loads upon the wheels.

The system of roads so far laid out traverses every portion of the island; it includes several main roads, and several miles of roads whose importance is chiefly local. The towns of Northfield and Westfield on the west side of the island, which are now separated by the estuary known as the Freshkills, are to be brought into communication by a trestle across the meadows and a drawbridge over the creek on the line of the Old Stone Road, which intersects the Freshkills road in Westfield. Plans and specifications are now being prepared for this bridge, which will be submitted to the Board of Supervisors, and after its acceptance proposals for its construction will be asked for by public advertisement. They provide for a pile trestle 16 ft. clear width, set 5 ft. above high water line. Pile piers will be built in the center of the creek, and a drawbridge, with central pier of iron or wood, will span the channel of the same, having clear openings of 30 ft. The total length of the trestle and drawbridge will probably exceed 2,500 ft. Examinations of the substrata of the bed of the creek and the meadows are now being made. The work is expected to be completed before spring.

The following are the proportions of the several classes of pavement on the total 30 miles of road under contract, viz.: telford pavement, 8 miles; macadam, 15 miles; repairs, 7 miles. All the telford is 12 ins. in thickness and 16 ft. wide or more. The macadam is about equally divided between 6-in. pavement 14 ft. wide, and 8-in. pavement 16 ft. wide. Nothing less than the former as to width and depth is allowed by law.

The work now being done is authorized by an act of the last Legislature of this State (Chap. 555) entitled, "An act to provide for the improvement and maintenance of the public roads in certain counties as county roads," which was passed shortly after the defeat of the Governor's State Road bill. Its principal features are as follows: It lodges with the Board of Supervisors of certain counties power to assume certain roads and designate them as County Roads for the purpose of improving and maintaining the same, the money for which is to be raised on county bonds, provides for the work to be done under the supervision of an engineer, and sets forth a code of regulations to govern the construction and maintenance of such roads, together with other customary enactments. By the terms of the bill the amount of money that can be collected from the county at large for the construction of any road is limited to the rate of $10,000 per mile. Any excess over and above this amount must be levied on the town in which said road is built. In only two cases will the moneys to be expended on roads exceed this limit and the total amount of the excess is small.

The following is an abstract of the specifications:

Specifications for Macadam Pavement.—The roadway is to be graded to such depth that when shaped and rolled the subgrade shall conform to the grade established by the engineer. Should any spongy, vegetable or objectionable matter be encountered, it shall be removed and the space carefully filled with clean gravel or fine cinders, and thoroughly rolled; In excavation and embankment the sides of the roadway shall have a slope of 1½ horizontal to 1 vertical. Where under drains are necessary they are to consist of 3 or 4-in. earthenware drain pipe laid with open joints. The road-bed must be rolled to ultimate resistance with a roller weighing not less than 10 tons, and giving a compressing power of not less than 400 lbs. per lin. inch. Whenever rolling is impracticable the engineer may cause the contractor to ram the same until it is consolidated. After the road-bed has been formed and rolled and has passed the inspection of the engineer, the stone roadway is to be constructed.

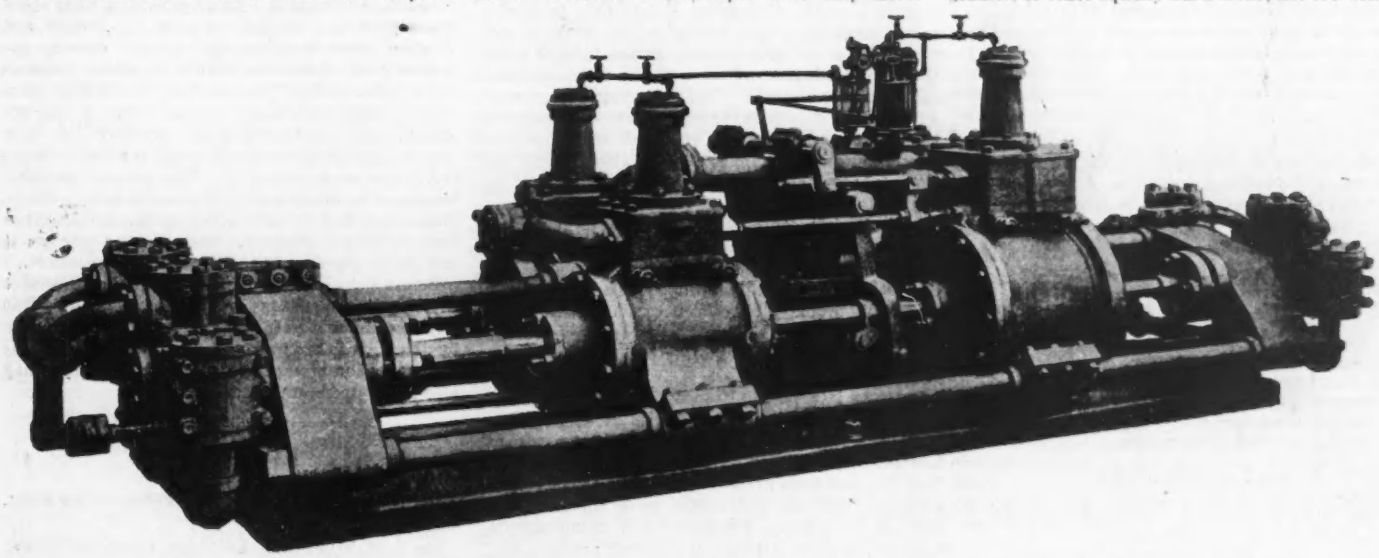
The stone is to consist of best trap rock of such size as will pass in any direction through a 2½-in. ring; it is to be broken into shapes as nearly cubical as possible with the most approved modern stone crushing machinery, and must be free from earth or other objectionable substances. The stone is to be applied in 2 courses, the first course being about 4 ins. deep. The contractor will not be allowed to dump the stone in heaps on the area over which it is to be spread, and then rake or shovel it down over the place where it is dumped; but must deposit it in front of the work, either on the roadbed, or, to facilitate handling, on a dumping board, and must throw it back so as to properly distribute the broken stone. The whole surface is then to be rolled dry, or with a moderate use of water, and all depressions are to be filled up with stone, and the roadway brought to a proper grade and curvature. A second course of the same material is then to be spread and rolled as above, after which the binding material of granite or trap rock screening is to be spread. Water is then to be applied in such quantity as to fill all voids with the binding material, and to produce a wave before the wheel of the roller. In rolling, the roller must start from the sides and work towards the center of the roadway. The contractor is to pave side gutters with cobble stones, as directed; crosswalks are to be laid in two courses of best Belgian bridge stone, 3 to 6 ft. long, 2 ft. wide and 6 ins. thick, on a bed of sand 4 ins. deep; courses to break joint 1 ft. One row of trap rock paving blocks to be laid between the courses of bridge stone, and one or two rows on each outer side.

Specifications for Telford Pavement.—The preliminary work is to be the same as that already described in the first paragraph of the specifications for macadam pavement.

The stone for the foundation will be of trap rock, granite, or other equally hard stone, not too brittle or friable; each stone 8 ins. deep, 8 to 15 ins. long, width not to exceed 5 ins. on top and not less than 4 ins. on the bottom. They are to be laid by hand in a close pavement, being set on their broad est sides, with their length at right angles to the road. They are then to be firmly wedged by stones of the same quality and depth, inserted in all possible places and driven down with bars or hammers. All projections of the upper surface are then to be broken off with a hammer, and the spawls and chips worked into the interstices. A border course is to be laid on each side, consisting of stones not less than 12 ins. long, 5 to 8 ins. wide and 8 ins. deep, care being taken to break bond every alternate stone. When 600 ft. of the foundation are laid the engineer may direct the contractor to ram or roll it; if rolling is impracticable on the foundation more stone is to be applied and the rolling continued.

Upon this foundation will be laid a single course, 4 ins. deep, of broken stone; this will be rolled, finished with binding material, and then rolled and watered, as already specified for macadam pavement. The cross walks are also to be as already specified. Any old macadam or broken stone excavated from the roadbed, which may be deemed suitable, shall be incorporated into the new work.

Specifications for Repairs to Macadam Pavement.—The roadway is to be cleaned until the stone is laid bare, and the surface picked up to a depth of not less than 2 ins. by hand, either with or without the assistance of a steam road roller, with spike attachments. Any objectionable material is to be removed, and the road bed put in good condition. Where the depth of the present pavement is insufficient it is to be excavated and broken stone applied in layers and rolled or rammed. Upon this is to be laid the new macadam in one or more courses, and this is to be rolled and watered as already specified for macadam pavement.



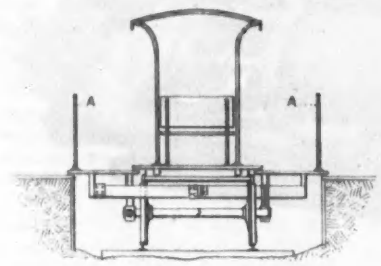
COMPOUND DUPLEX HYDRAULIC PUMP. BUILT BY THE BUFFALO STEAM PUMP CO.

A Multiple Dispatch Railway.

Everybody remembers the busy little narrow-gauge railway at the Centennial Exposition, which made the circuit of the grounds, starting from the Main building, and carried nearly 4,000,000 passengers during the six months of the exposition. At the Paris Exposition of 1889 the 2-ft. gauge railway of DECAUVILLE [ENGINEERING NEWS, June 1, 1889] and the novel *Chemin de Fer Glissant* [ENGINEERING NEWS, Aug. 31 and Oct. 26, 1889] were two exhibits which attracted hardly less attention than the Eiffel tower itself. At the World's Columbian Exposition of 1893, Chicago proposes to eclipse all previous achievements in transporting passengers about the grounds by building what has been christened a multiple dispatch railway.

A cross section of this novel transportation line is shown in the accompanying sketch. The railway consists of three endless platforms, the center one moving at twice the speed of those on each side. The motion is to be continuous, and not so fast but that passengers can step on and off with safety when they please.

The chief point of interest from a mechanical point of view is the means proposed for carrying the center platform at double the speed of those on the side. As seen in the sketch the three platforms are carried on a two-wheeled truck. The side platforms are carried on the axles of the truck in the ordinary manner, but the center platform rolls on the wheel treads and of course goes twice as fast, since the horizontal movement of the top of a rolling wheel is twice that of its centre. Near the outer edge of the side platforms will be stanchions and



Cross-Section of Multiple Dispatch Railway for World's Columbian Exposition.

hand rails (marked *A A* in the sketch), placed at frequent intervals to assist passengers in getting on or off. The inner platform will have a canopy and seats, and will, of course, be the one principally used, the slow moving platforms at each side being only intended to enable passengers to safely get on and off. To prevent the catching of feet in crevices between the platforms they are to slightly overlap, as shown. The sketch is only intended to show the general principles of the scheme, and probably in practice the central platform would be made about double the width shown, to accommodate four persons on a seat. It is estimated that with this width a road 3 miles in length will accommodate 20,000 persons at a time. The speed proposed is 3 miles per hour (4½ ft. per second) for the slow platforms, and 6 miles per hour (9 ft. per second) for the central platform. This would give a carrying capacity of 40,000 passengers per hour for the whole circuit.

There seems to be no apparent difficulty in making the system a success as far as the mechanical details are concerned. How to give motion to the endless train is something of a problem, but a cable at the side seems the most convenient plan. Grades present no especial difficulty, but varying curvatures will necessitate some provision for lateral motion between successive links of the endless train. Grade crossings, it need scarcely be said, will be necessarily absent; there will be no signals to start or stop, no gates to open and shut, no fares to pay, and operating the railway when once it is started should be a very simple matter. If it breaks down anywhere, however, the whole train must stop, as a matter of course. The point on which the success of the scheme hinges is whether the public which patronises it can keep its balance. A certain number of falls will be inevitable, but it does not seem likely that anything worse than a bumping will be the result. Of course the railway will not be a place for the aged and infirm; and the careless ones who walk on or off backwards and sit down hard will have to pick themselves up amid the audible smiles of those about, but for any reasonably active man it will be much less difficult to board the train than to step on a moving horse car. If it is desired to make provision for weaker passengers, it might be done by the provision of wheeled chairs, with attendants, along the line, which could be run on to the outer platform, and then run alongside at the speed of the center platform, to which the occupant would step as on to a stationary platform.

The chances for the adoption of this proposed railway by the managers of the Columbian Exposition are said to be very good. Among those interested in the enterprise is MAX O. E. SCHMIDT, M. Am. Soc. C. E., who has taken a leading part in preparing the designs. Such a plan is conveniently adaptable at places like an exposition, where speed is not an object, and passengers are entering and leaving at many points, and for such a traffic the idea seems to have points of merit, as it certainly has of novelty.

The Preservation of Timber.

Mr. O. CHANUTE, in a late address before the students of the Rensselaer Polytechnic Institute, gave a most interesting résumé of the various processes for preserving timber. Space forbids more than a brief abstract of some of the more striking points in this address. Mr. CHANUTE commenced with a short sketch of the work of the committee of the Am. Soc. C. E., of 1880, of which committee he was a prominent member, and he also referred to the good work done by the U. S. Department of Agriculture.

Speaking of metallic ties, Mr. CHANUTE remarked that the time had not arrived in this country for their extensive use. England prefers wooden ties creosoted to metallic ties. In France every tie is artificially prepared to resist decay, creosote being principally used. In Germany ties are preserved by creosote and the use of chloride of zinc, the latter prevailing.

During a late visit to France Mr. CHANUTE found that there were about 94,000,000 ties in use. These have been renewed in the last ten years at a rate of 4,000,000 per year, or 4.2% at a cost of 70 cts. each. Had they not been prepared, judging by prior experience, the renewal would have amounted to 10.6% at 68 cts. each. The cost of preserving each tie is 25 cts., or $1,000,000 for the renewal account, and the net economy was $3,000,000, by preserving ties against decay. Mr. CHANUTE, basing his figures on the 1890 report of the U. S. Department of Agriculture, says that the 515,892,918 ties in tracks in the United States, require annually in renewals 60,034,647, or 11.6%. On the French basis of 4.2% there would be a saving 38,362,647 ties per year, which at the low price of 35 cts. each would amount to $13,426,926. If the cost of preparing 21,672,000 ties, at 25 cts. each, were deducted from this amount, the net annual saving to railways would be $8,008,926.

Speaking of metallic ties, Mr. CHANUTE said that at present a metallic tie can not be put down for less than $2.50. Borrowing money at 5% shows that this tie costs 12½ cts. per year, which is more than the present cost of unprepared wood. An oak tie will cost 70 cts. and last 7 years, an average of 10 cts. per year, as against 12½ cts. as above figured. But a hemlock tie, costing 35 cts., can be prepared for 20 cts. more. This tie, at 55 cts., will then last 12 years, or it will cost about 5 cts. per year only. Mr. CHANUTE believes that true economy in this country lies in the preparation of the inferior and cheaper kinds of woods. In selecting these open-grained and hard woods are best, as taking the larger volume of the chemicals, and yet resisting cutting and pounding by the foot of the rail. Mr. CHANUTE called special attention to the enormous difference in the receptivity of various woods, and gave various experiments to prove this. Careful tests are necessary to establish this important point, and for the same reason railroad ties should be cut in winter when the sap cells are most nearly empty. Before treatment timber should be seasoned and the moisture evaporated. French experiments show that fresh-cut elm will absorb 26% of its weight of solution; well seasoned it will absorb 69%. Fresh beech will absorb 21%, seasoned, 47%; and fresh poplar, 27%, seasoned, 59% of its weight.

The process for preservation most in favor in Germany is the solution of chloride of zinc, which is used at ¼ to 1% strong to effect actual preservation. Americans use twice that quantity, because of the difference between individual trees.

According to a table prepared by Mr. CHANUTE, the proper rate of absorption for the various processes is as follows: For creosote, 10 lbs. per cu. ft., or 833 lbs. per 1,000 ft. B. M., and for preservation against the teredo, 15 to 19 lbs. per cu. ft. For sulphate of copper the solution should be 2% strong, and the amount 34 lbs. per cu. ft. For chloride of zinc the solution should be 1.6% strong, and the quantity absorbed 0.26 lbs. per cu. ft., or 21 lbs. per 1,000 B. M. For corrosive sublimate there should be 0.06 lbs. per cu. ft.; but this quantity is so minute that when exposed to moisture it will wash out more than any of the other salts mentioned. Mr. CHANUTE described at length the process of treating hemlock with chloride of zinc, as performed in Chicago.

The cost of the various processes is given as follows: Bichloride of mercury, 10 cts. per tie; but this does not provide for its sufficient injection to do much good. It was abandoned by the road using it after five or six years' trial. The cost of sulphate of copper would be about 24 cts. per tie; this is not recommended. Chloride of zinc preservation costs about 20 cts. per tie. Creosote, as used in France and England, costs 60 cts. per tie. In this country the normal price of creosote is 8 cts. per gallon, as there is a greater demand for coal-tar for roofing here than in England, where creosote costs 4 cts. per gallon. The supply here is also growing less each year as naphtha-charged water gas is being substituted for gas made from coal. Creosote will probably lengthen the life of a tie to 20 years at a cost of 60 cts. But at a cost of 20 cts. chloride of zinc will lengthen this life to 12 to 16 years. The creosote process is the best, therefore, but not the most economical.

Before ties are prepared they should be allowed to dry by piling them for two or three months. The Germans mark ties for reference and examination by driving into it a galvanized nail having the year of preparation stamped in the head. They may also be stamped on the ends.

PERSONALS.

Mr. ROBT. A. CAIRNS has been elected City Engineer of Waterbury, Conn.

Mr. J. W. MARTENIS, has been appointed Traffic Manager and Auditor of the Wilmington, Onslow & East Carolina R. R.

Mr. S. B. OPDYKE, Jr., of Hartford, Conn., General Superintendent of the Central New England & Western R. R., has resigned.

Mr. E. B. THOMAS has been elected First Vice-President of the New York, Lake Erie & Western R. R., vice Mr. S. M. FELTON, JR., resigned.

Mr. W. H. HIPPLE has been appointed Chief Inspector of Bridge and Track Material of the Pennsylvania R. R., vice Mr. A. GILPIN, resigned.

Mr. WM. METCALF, M. Am. Soc. C. E., of the class of '58 of the Rensselaer Polytechnic Institute, delivered a lecture on steel before the students of that institution on Dec. 9.

Mr. WALTER SCOTT CHISOLM, of Savannah, Ga., Vice-President of the Plant system of railways, died Dec. 5. He was a Director of the Richmond Terminal Co. and the Central R. R. of Georgia.

Mr. S. H. H. CLARK has been appointed General Manager of the Union Pacific Ry., and Mr. W. H. HOLCOMB has been appointed Assistant General Manager, with offices at Omaha, Neb.

Mr. W. F. TURREFF, late Superintendent of Motive Power, of the Cleveland, Cincinnati, Chicago & St. Louis, Ky., has been appointed Master Mechanic of the Chicago & Erie division of the N. Y., L. E. & W. R. R. vice Mr. LATTA, resigned.

Mr. E. T. MCCONNELL has been appointed Engineer of Maintenance of Way of the Peoria division of the Cleveland, Cincinnati, Chicago & St. Louis Ry. This appointment was incorrectly mentioned last week as having been given to Mr. W. A. MCCONNELL.

Mr. SAMUEL M. GRAY, of Providence, R. I., has been appointed as expert engineer by the City Council of Rochester, N. Y., to make an examination, and report upon the plan proposed by Mr. EMIL KUICHLING, C. E., for the interception and disposal of the sewage of the city of Rochester, east side.

Mr. A. L. DENNIS, of New York, died Dec. 8. He was at one time President of the New Jersey R. R. & Transportation Co., now leased to the Pennsylvania R. R.

Co., and President of the United Railroads & Canal Co. of New Jersey; Vice-President of the Naugatuck R.R.; President of the Jersey City Ferry Co., and a Director of the Delaware, Lackawanna & Western R. R.

Major P. W. O. KOERNER, of Ellaville, Fla., died at Atlanta, Ga., Nov. 30. In 1859 he surveyed the first railway proposed in Florida, from Fernandina to Tampa. From 1857 to 1860 he was engaged in locating the Transit road, after which he changed the line of the Peninsula road, and was Assistant Engineer under Col. Gillmore in the surveys for jetties at Fernandina. He located and built, as Chief Engineer, the Fernandina & Jacksonville R. R.

Mr. WILLIAM B. KNIGHT, who was injured in the Jacksonville Junction wreck, on the Chicago, Alton & Wabash R.R., on Dec. 3, died on Dec. 6 in Jacksonville, Ill. Mr. KNIGHT was born in New York City in 1847, and was educated at the Rensselaer Polytechnic Institute of Troy, N. Y. In his earlier engineering practice he was associated with the construction of the quadruple tracks of the New York Central between Albany and Buffalo; was for two years on the Panama Ry., and was engaged on the new sewerage work at Boston. In 1879 he removed to Kansas City, after serving a term as Surveyor of New York City. In the first named city he went into partnership with Mr. DANIEL BONTECOU, and the firm was soon associated with the great engineering works of Kansas City. Among these the principal one was the construction of the Grand Ave. cable system. In 1881 Mr. KNIGHT was appointed City Engineer and held this office until 1885. After leaving this department he became Chief Engineer of the Metropolitan Street R. R. Co., and Chief Engineer of the Kansas City, Independence & Park, the Belt Line, the Kansas City, Wyandotte & Northwestern, and a half dozen other similar concerns. At the time of his death he was Chief Engineer of the Tacoma (Washington) R. R. & Motor Co., Kansas City & Suburban Belt Ry., Union Depot Co., Kansas City Belt line, Augusta., Ga., Electric Ry. Co., Joplin, Mo., Electric & Motor Ry. Co., Metropolitan Street Ry. Co. Mr. KNIGHT was made a Junior of the Am. Soc. C. E. in 1875, and a Member in 1880. In 1887-88 he was President of the Kansas City Engineers' Club. Mr. KNIGHT was a passenger on the sleeper "Matterhorn," which was run into by a coal train at the Jacksonville crossing. His death was caused by scalding, by steam from the heating pipes and the wrecked engine of the coal train.

NEW PUBLICATIONS.

—*Mechanics of Engineering and of Machinery.* Vol. III., Part I., Section II.; the Mechanics of the Machinery of Transmission. By Dr. JULIUS WEISBACH. Second edition revised and enlarged by Prof. GUSTAV HERRMANN. Translated by Prof. J. F. KLEIN. Pp. 549, 8vo. $5. John Wiley & Sons, New York.

This volume is a careful translation of a small part of the edition of the late Dr. WEISBACH'S "Mechanics" now being published in Germany. Some idea of the care with which Prof. HERRMANN is editing the work may be obtained from the fact that the preface to the first volume of the edition is dated October, 1874, and all the volumes are not yet issued; in fact only a mere trifle of nearly 6,000 closely printed octavo pages are now on our shelves. In the introduction to the whole work, it is stated that WEISBACH'S great service to the engineering profession lies in the geometrical rather than the analytical treatment which he adopted, although the editor admits that the latter is usually more concise. It is interesting to compare this volume with similar matter written by another great engineer, RANKINE, who, however, has never to our knowledge been accused of too great simplicity. Such a comparison shows at once the difference between the two men. WEISBACH wrote for engineers who are supposed to have forgotten their higher mathematics, but are perfectly familiar with geometry and trigonometry, while a knowledge, not a smattering, of the calculus and analytical mechanics is absolutely essential before RANKINE'S volumes can be well understood. Engineering is not an exact profession and the long and unwieldly methods of geometry are therefore sufficient to answer most of its requirements. But they are tedious, and the technical schools are pursuing an excellent course, in requiring a good knowledge of modern mathematics before graduation, for the time spent in acquiring this knowledge means a large saving of brain work later on.

The volume before us contains articles on ropes and chains, screws, crank and cam trains, engaging and disengaging gear and regulators, together with an appendix on the graphical statics of mechanism. The nature of the treatment we have already indicated, and the numerous solved problems and illustrations make the chapters as clear as technical subjects allow. The translation is unusually exact, and the illustrations are faithful reproductions of the German originals. The press work is excellent. We cannot understand, however, how the publishers of such artistic editions of Ruskin as come from the press of Wiley & Sons, can print on the title page of this book "with more than four hundred *fine* illustrations." They are in the German style of cheap wood cuts of 1876, and while good as diagrams are not up to the present standard.

—(*In press*) *The Washington Bridge over the Harlem River, at 181st St., New York City.* A description of its construction by WM. R. HUTTON, Chief Engineer. Illustrated with 26 Albertypes and 37 double and single page lithographs. LEO VON ROSENBERG, publisher, 35 Broadway, New York. Large quarto. Price $2, postage paid.

In commencing a notice of what is the most completely illustrated history of a bridge that ever came to our desk, it may be well to give some of the general features, as a measure of relative importance among bridges. This bridge is for highway purposes and has a total length of 2,375 ft. The clear span of each of its two metal arches is 510 ft., and the 7 granite approach arches are each 60-ft. in span. The bridge is 80 ft. wide and the roadway has a height of 151 ft. above mean high tide. Work was commenced in July, 1886, and the bridge was completed in February, 1889. The entire cost, including engineering, superintendence and the expense of the Commissioner's office, was $2,851,684 to December. 1888, when the structure was practically completed.

The history of this structure is given from its inception in 1869, and to Mr. ANDREW H. GREEN certainly belongs the credit of persistently pushing this project to a successful end. The portion devoted to the masonry gives the material and character of this portion of the work, and includes a detailed description of the caisson foundations, with their dimensions, quantities, methods of sinking, etc. The description of the stone superstucture is then followed by that of the metal work, its sections, dimensions, erection, etc. A somewhat unusual but commendable part of the work is a full list of those occupying any position of responsibility throughout the progress of the work, commencing with the Commissioners and ending with the inspectors. In this connection it may be said that the chief engineer was WM. R. HUTTON, with THEODORE COOPER, and, to August, 1886, WM. J. MCALPINE as consulting engineers, and E. H. KENDALL as consulting architect. ALFRED NOBLE, as resident engineer, had charge of the caissons and general foundation work, and the completion of the main piers above the skewbacks; he resigned in June, 1887, and was succeeded by JOHN BOGART. The contractors were the Passaic Rolling Mill Co. and MYLES TIERNEY. FRANK A. LEERS, engineer of the Passaic Works, designed all the working drawings for the metal work, in consultation with Mr. COOPER. Messrs. Anderson & Barr sunk the caissons. A discussion and tables of the stresses in members form a part of this work, which is concluded by a condensed statement of quantities and cost, contract and specifications, contract prices and revised prices, tests of materials, etc.

The marked and especially valuable features of this publication are the series of photogravures, showing the structure in progress and finished, from many points of view, and the series of plates showing details of metal work and masonry, erection plant, etc. Among the most interesting sets of illustrations is one showing 14 of the earlier plans proposed for bridges at this same site, all drawn to a common scale with the elevation of the bridge as built. Another series, of a common scale, contrasts the Washington bridge with the other great metal arched structures of the world. The progress photographs show very clearly the rate of construction as they date from November, 1886, to November, 1888. We understand that the publisher, Mr. VON ROSENBERG, is chiefly, if not altogether responsible, for the excellent character of the illustrations used throughout, and we cordially testify to his industry, patience, judgment in selection and general taste in the form of presentation of this important part of the work. The illustrations would tell their own story, even with a minimum of text, and no detail seems so trivial as to have escaped record. We sincerely trust that the good work done in this volume may be widely appreciated among engineers and bridge builders.

—*Bibliotheca Polytechnica.* Directory of Technical Literature. First annual issue, 1889. Edited by Fritz von Szczepanski. Cloth, 12mo, 80 pp. International News Co., New York. 75 cents.

The object of the author has been to compile a priced catalogue of all the leading books and papers published in America, England, France and Germany relating to technical subjects. In endeavoring to compress the matter into as small a space as possible a large number of cross references in English, French and German have been used, and the result is occasionally confusing. The main heads are in German, with the French and German equivalents printed immediately afterward. It is due probably to such a polyglot arrangement that the "Fireman's Guide: a Handbook on the Care of Boilers," is indexed under "Feuerwehr, pompiers, fireman," and Bucknill's "Submarine Mines and Torpedoes" under "Schiffsmaschinen" (marine engines). While there are a number of omissions of American publications, the work seems to have been done with care, and the first issue is certainly a credit to compiler and publisher.

—*The Metal Schedule of the Tariff Act of 1890 Compared with the Old Tariff Law.* With index. Prepared by the American Iron and Steel Institution. Philadelphia, No. 261 South Fourth St. Price $1.00. A very useful publication for comparing the old and new laws as far as metals are concerned.

—*Asphalt Pavement. What is it! Where is it! Why it succeeds! A few words from the Business Men's Cycle League, of Newark, N. J.* By C. R. HOAG, Secretary. A 12-p. pamphlet urging the advantages of asphalt pavement over other paving materials; illustrated by well selected opinions on this subject as to cost, maintenance, cleanliness, smoothness, etc.

TRADE PUBLICATIONS.

—*The National System of Purifying Water, for public water supply manufacturing and private residences.* Published by the National Water Purifying Co., 145 Broad way, N. Y. Treats generally of the purification of water; describes the National filter, with its operation, various applications, etc. The phamphlet closes with a list of users of these filters with a number of testimonials from these users.

—*Pedrick & Ayer, Catalogue of 1001, 1001 & 1003 Hamilton St., Philadelphia.* A handsomely printed and illustrated descriptive list of the milling, boring, planing and shaping machines and their appliances manufactured by this firm. Each tool is separately shown, and its working and advantages plainly set forth. The Richards open-side planing and shaping machines have many special practical advantages, which are here explained.

—*Catalogue of the Bridgeport Machine Tool Works.* E. P. Bullard, proprietor, Bridgeport, Conn., 1890.—A collection of exceedingly well engraved illustrations of the line of machine tools, for general shop and manufacturing purposes, made by this firm. These include boring and turning mills, bolt-cutters, chucking machines, compound turrets, lathes, screw machines, etc. Each tool is described and weight and dimensions given. This catalogue is well worth study as an excellent exhibit of the best arrangement in boxed frames, proportion of parts, and general grace and strength of form.

—*Consolidated Car Heating Co., Catalogue No. 1,* 7 × 10 ins., pp. 120. The Consolidated Car Heating Co., Troy, N. Y.

The advance sheets of this excellent catalogue, which contain the description of some of the latest devices brought out by this company, were reviewed in our issue of Sept. 6. Beside the interesting matter then given, the complete volume describes a return system of heating especially suitable for elevated railroads, a hot water storage system for street-car heating, a machine for fastening couplers to hose, and various types of independent fireproof water heaters. Good progress is reported on the new coupler and the system of electric lighting, which are to be placed on the market next season. The company states that the total number of steam couplers which it has sold is now 25,000.

SOCIETY PROCEEDINGS.

New York Railroad Club.—Besides the paper on "Brake Rigging," by Mr. B. A. Parke, announced last week for the meeting on Dec. 18, Mr. W. G. Wattson will read a paper on "Car Service."

Schenectady Technical Association.—This society has been formed by the Faculty of Union College, men engaged with the Edison Electric Works and the Schenectady Locomotive Works and local engineers. At the meeting on Dec. 4, Prof. Maurice Perkins, the President, read a paper on "Ancient Theories as to the Elements of Matter." At the next meeting, on Dec. 18, a paper on "Dynamo Designs" will be read by Emil Kolben.

Engineers' Society of Western Pennsylvania.—Meetings of, Sept. 16 and Oct. 21. The chief business at the last meeting was the report of Mr. A. E. Hunt, the delegate to the Chicago meeting, convened to arrange for the international engineering convention of 1892. Prof. John W. Langley then presented his paper on "European Bessemer Practice in Small Converters," which was read and discussed.

J. A. BRASHEAR,
Secretary *pro tem.*

Western Society of Civil Engineers.—Meeting Dec. 4. Mr. Max E. Schmidt described, by the aid of drawings, "The Multiple Dispatch Railway." This is a series of parallel planes on wheels, with the outer edges or planes moving at the rate of 3 miles, and the middle portion at 6 miles per hour. It is proposed to use this device at the Exhibition of 1892. At the same meeting Mr. Stuart described the de Bausset air-ship. The principle is that of a hollow steel cylinder, absolutely rigid, and propelled by 8 independent "exhausting" screws driven by electric motors. The cylinder is to be 728 ft. long, 144 ft. in diameter, and the air will be exhausted from it by pumping. The proposed car would carry 175 tons of load. The next annual meeting of this society will be held Jan. 7 at the Sherman House, Chicago. Mr. D. J. Whittemore announced the discovery, in Dakota of inexhaustible beds of cement rock of most excellent quality.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

Vol. XXIV. Saturday, December 13, 1890

D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
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COMING TECHNICAL MEETINGS.

Engineers' Club of Philadelphia.—Next meeting, Jan. 3. Secy., Howard Murphy, 1122 Girard St.

Western Society of Engineers.—Next meeting, Jan. 6. Secy., J. W. Weston, 280 La Salle St., Chicago.

Engineering Association of the Southwest.—Next meeting, Jan. 8. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

Civil Engineers' Club of Cleveland.—Next meeting, Jan. 13. Secy., A. H. Porter, 50 Euclid Ave.

New England Railroad Club.—Next meeting, Jan. 14. Secy., F. M. Curtis.

Southern and Southwestern Railway Club.—Next meeting Jan. 15, at Atlanta, Ga. Secy., W. H. Marshall, Rookery, Chicago.

New York Railway Club.—Next meeting, Dec. 18. Rooms, Gilsey House.

Western Railway Club.—Next meeting, Dec. 16. Rooms, Phenix Building, Chicago. Secy., W. D. Crosman, 816 Rookery Bldg.

Engineers' Club of Cincinnati.—Next meeting, Dec. 16. Secy., J. F. Wilson.

Engineers' Society of Western Pennsylvania.—Next meeting, Dec. 16. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, Dec. 17. Secy., S. E. Tinkham.

Engineers' Club of St. Louis.—Next meeting, Dec. 17. Secy., W. H. Bryan, 30 South 7th St.

Denver Society of Civil Engineers.—Next meeting, Dec. 23. Secy., Geo. H. Angell.

Civil Engineers' Society of St. Paul.—Next meeting, Jan. 5. Secy., G. L. Wilson.

Technical Society of the Pacific Coast.—Next meeting Jan. 9. Secy., O. von Geldern, 408 California St., San Francisco.

American Society of Civil Engineers.—Next meeting, Dec. 17. Secy., John Bogart, 127 E. 23d St., New York.

Civil Engineers' Association of Kansas.—Next meeting, Jan. 14. Secy., J. C. Herring, Wichita, Kan.

Northwest Railroad Club.—Next meeting, Dec. 16. Secy., H. P. Robinson, St. Paul, Minn.

THE article on measurements of wind velocities and pressures, by Prof. C. F. MARVIN, of the Signal Service, which appears in another column, is well worthy of careful study by all those interested in this problem, and is one of the most satisfactory articles on this subject which we have seen. It describes some very careful recent experiments made on the top of Mt. Washington which, within their range, are seemingly conclusive; the only trouble being that their range is somewhat narrow, both as to the velocities and the areas observed. The net results of the observations may be summarized as follows:

Old Smeaton Formula,	$P = .005\ V^2$
As determined by Prof. MARTIN,	$P = .004\ V^2$
" " WHIPPLE and DINES,	$P = .0029\ V^2$

At 60 miles per hour these formulas give for the pressure per square foot, 18, 14.4 and 10.44 lbs. respectively, the pressure varying by all of them as the square of the velocity. Lieut. CROSBY'S experiments, described by us in June last, and claiming to prove that $P = f\ V$ instead of $P = f\ V^2$, are discredited; a result which we must confess, is in accordance with our impression of probabilities, although it cannot be regarded as affirmatively established beyond reach of doubt until much higher velocities than 60 miles per hour have been observed. The Signal Service can render a great service to science by continuing experiments up to 100 and 200 miles per hour on proper apparatus, and can easily get the money for constructing such apparatus, we should judge, by proper applications to Congress. Moreover, the admirable observations on Mt. Washington, ought certainly to be supplemented by further observati ns on areas both larger and smaller than 4 to 9 sq. ft., and on variously reticulated as well as solid surfaces. Until these things have been done, and well done, there will remain a serious element of doubt about all wind-pressure formulas.

ALL necessary legal authority has at last been granted for the construction of a tunnel under the East River to connect the Long Island Railroad with the railways centering at the 42d St. Station, and it is greatly to be desired that the work should be pushed ahead, since there is no danger but that it will have ample traffic to justify its existence, and it would doubtless be the precursor of several others. We have only to look at the number of elevated and surface railways connecting up-town with down-town New York to see that there is little danger of overdoing the matter. Experience clearly indicates that the effect of adding such means of communication between centers of population situated as New York and Brooklyn are, is not to divide the previously existing traffic, but rather to create new traffic of its own, so that in the end, all the lines have more traffic than before. Some foolish people thought the ferries and the street railways would be ruined when the Brooklyn Bridge and elevated railways were built. Some still more foolish people are now talking about "relieving" the East River Bridge by building new bridges or tunnels further up the river. A very little study of the situation would show them how utterly futile are such expectations. A very little observation will show that the actual communication between New York and Brooklyn is now vastly less (hardly one-twentieth) than what exists between up-town and down-town New York, or which would exist between New York and Brooklyn if the East River could be entirely eliminated, and the two cities moved up together. Any conceivable number of bridges and tunnels can only approximate to this condition; and therefore, until there are at least ten or a dozen such structures, there is no danger of any new one seriously encroaching upon the traffic of the earlier ones for any length of time.

THE following bit of quiet sarcasm so well hits off a not uncommon form of human folly that we reprint it in full. It is from a letter to *Engineering:*

There is an article in the current number of the *Journal of the American Society of Naval Engineers* upon the trials of a ferry-boat, written by Chief Engineer ISHERWOOD, of the United States Navy, which contains some figures that I would commend to the study of our makers of chronometers and revolution counters, who are evidently all behind the times.

The speed of the ferryboat, as measured on a two-mile course, is stated to have been 10.492776 knots, or 1,064.317246 ft. per minute. On another occasion, when a greater length of base, it is to be presumed, warranted the addition of another decimal place, the speed was 1,103.785656 ft. per minute. The indicated horse-power was 392.979757. Now, as the time measurement in the first case cited extended over some 595 seconds only, it follows that it was possible to read the chronometer to the one hundred-thousandth of a second. Moreover, as the limit of accuracy of the power measurements is fixed by the lowest limit of accuracy of its functions, the revolutions, which were 71 and a fraction per minute, must have been measured to the one-millionth part of a revolution. My mind quails at the thought of the minuteness with which the indicator diagrams, in all probability only an inch or two in height, must have been scaled in order to justify the recording of the horse-power to nine figures. One other quantity is worth quoting, and needs no comment: "The number of Fahrenheit units of heat imparted per hour in the boilers to the feed water supplying the main engine with steam" was 13,286,746.47564.

It is not necessary to elaborate the moral further than to say that a very much less degree of decimal precision than this is almost equally absurd when extending beyond the limits which the constants justify, and really discredits instead of accrediting both the work and the man who does it.

IF the pending election contest in the American Society of Civil Engineers does no other good, it will at least have the good effect of stirring up its members to an interest in its affairs, and compel them to indicate their real wishes as to its policy and management. For, while the personal question as to the office of secretary is an important one, yet as the contest is now shaping itself, it is becoming one of principles rather than of men. Since our last issue most of the scattering nominations have been declined, and the contest is now narrowed down to these two opposing tickets for the offices of vice-president, secretary, treasurer and director: Messrs. KATTÉ, TRAUTWINE, BOLLER and CHILDS upon the one hand, and Messrs. FTELEY, COLLINGWOOD, BOGART and BRUSH upon the other. Those who feel satisfied with the past management and policy of the Society, and wish it to continue in the future substantially as it has been in the past, favor the last-named ticket, which is, in fact, merely the present working Board renominated with the sole change of Mr. COLLINGWOOD in place of Mr. GREENE (for while the contested nominations are apparently for only four directors out of ten, yet those four alone practically control the Society under its antiquated and peculiar constitution). Those who feel dissatisfied with the past management of the Society, believing it to have been too narrow and localized, or negligent, or extravagant, or all three together, favor the first named ticket. It is well that the issue should be thus narrowed to two tickets only, as otherwise, not only would the result be unintelligible, but the election would probably be thrown into the Annual Meeting, which means that it would be decided by the resident members only.

As an aid to every member who may be seeking to inform himself as to the real merits of the contest from the practical point of view, we publish in another column, without comment, the facts of record as to the actual management of the finances of the three leading engineering societies during the past three years. We leave it to every voter to judge for himself as to whether these facts do or do not indicate efficient management of the society's affairs in one important respect, its finances; and as to whether they do or do not indicate that the society should have a working secretary who devotes his entire time to its service in return for the $4,000 to $4,500 which the office is now worth, including both salary and house rent. On the latter point we have not hesitated to express a decided opinion from the first. We hold that the paid secretary of such a society should be working for the good of the whole profession, and not of one member of it; and hence i

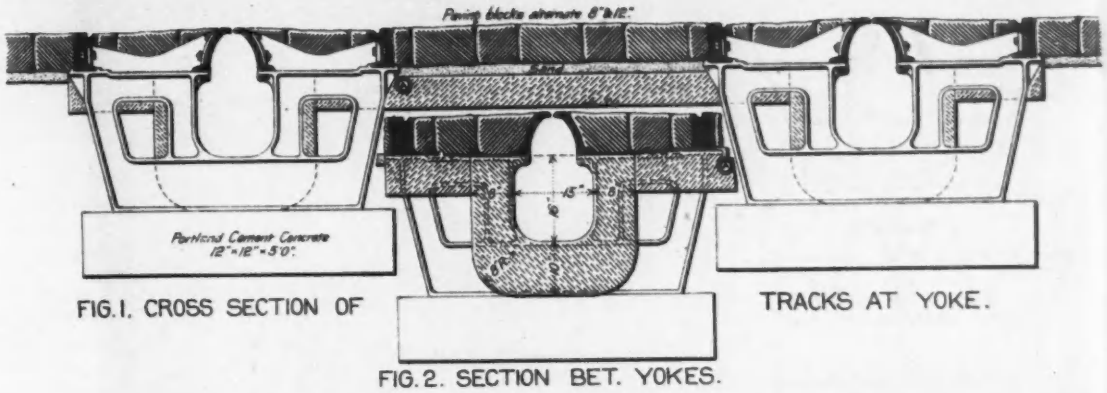


FIG. 1. CROSS SECTION OF TRACKS AT YOKE.

FIG. 2. SECTION BET. YOKES.

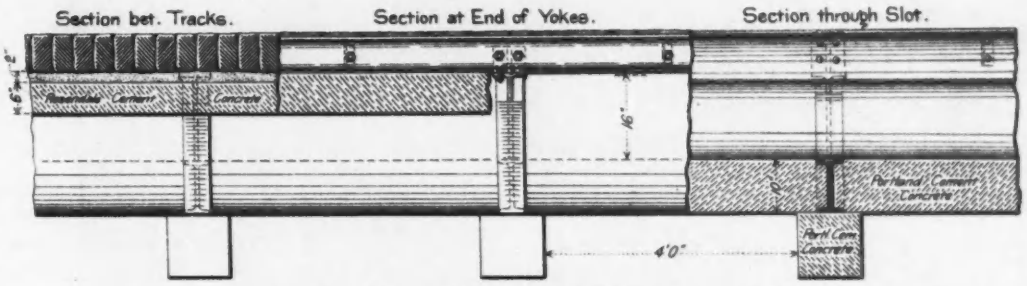
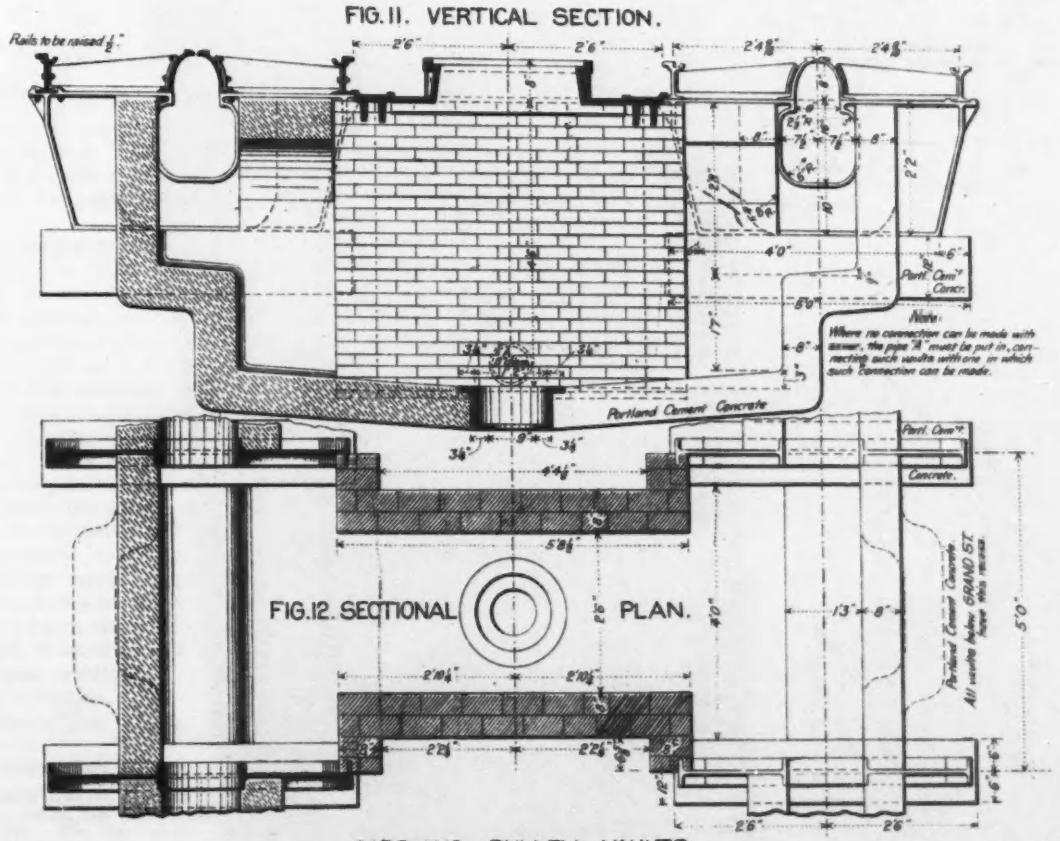


FIG. 3. LONGITUDINAL SECTIONS OF TRACK.

FIG. 11. VERTICAL SECTION.


Rails to be raised ½".
Portland Cement Concrete
Note:
Where no connection can be made with sewer, the pipe "A" must be put in connecting such vaults with one in which such connection can be made.
Portland Cement Concrete.
FIG. 12. SECTIONAL PLAN.
Portland Cement Concrete
All vaults below GRAND ST. have this recess

CARRYING PULLEY VAULTS.
MANHOLE PIT.

CABLE RAILWAY

FOR

THIRD AVENUE, NEW YORK CITY.

TRACK DETAILS.

A. H. LIGHTHALL, CHIEF ENGINEER.

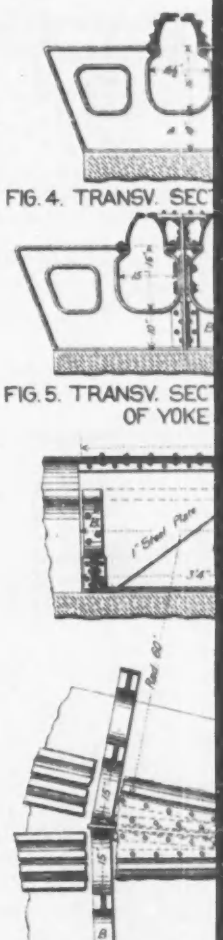


FIG. 4. TRANSV. SEC

FIG. 5. TRANSV. SEC
OF YOKE

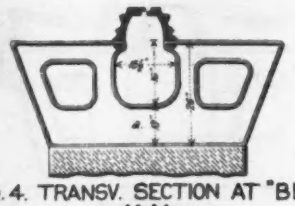


FIG. 4. TRANSV. SECTION AT "BB."

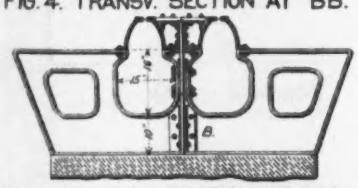


FIG. 5. TRANSV. SECTION AT BACK OF YOKE "B."

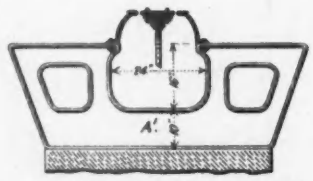


FIG. 6. TRANSV. SECTION AT "AA".

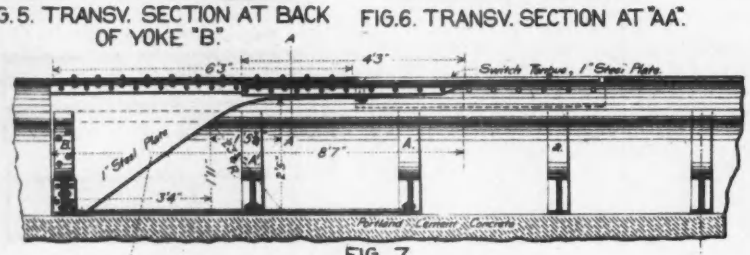


FIG. 7.
LONGITUDINAL SECTION.

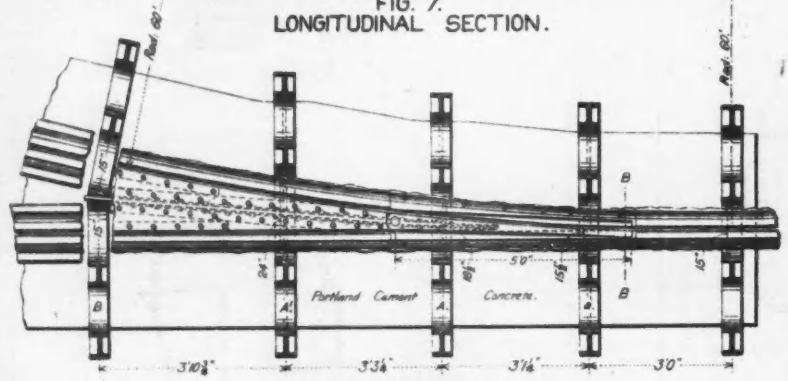


FIG. 8. SECTIONAL PLAN.

FIG. 9.
VERTICAL SECTION OF WHEEL VAULT THRO.

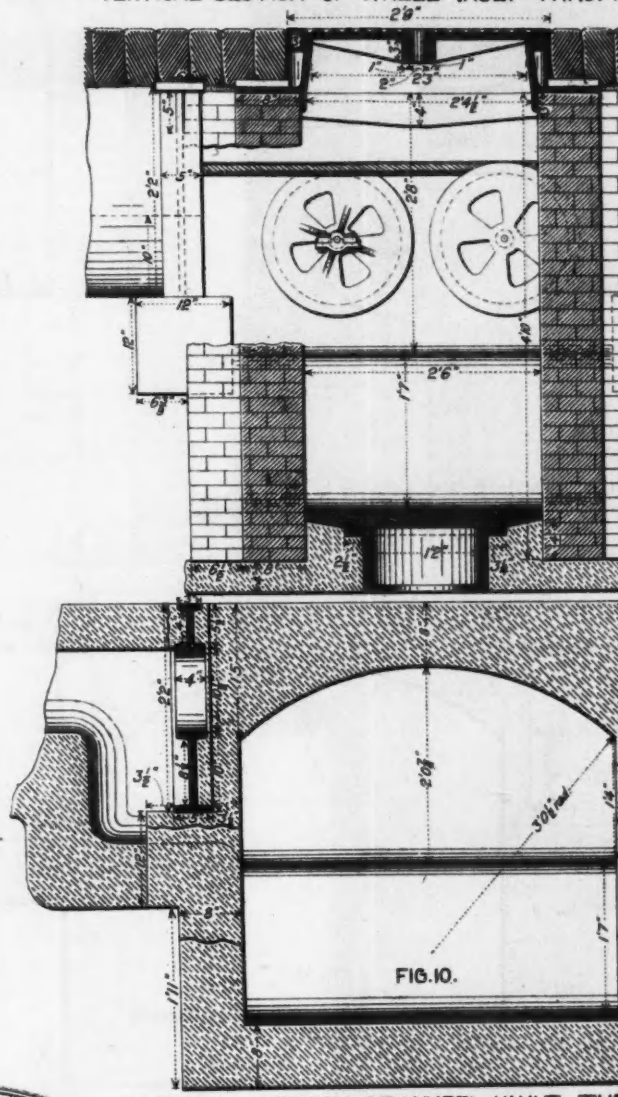


FIG. 10.

VERTICAL SECTION OF WHEEL VAULT THR

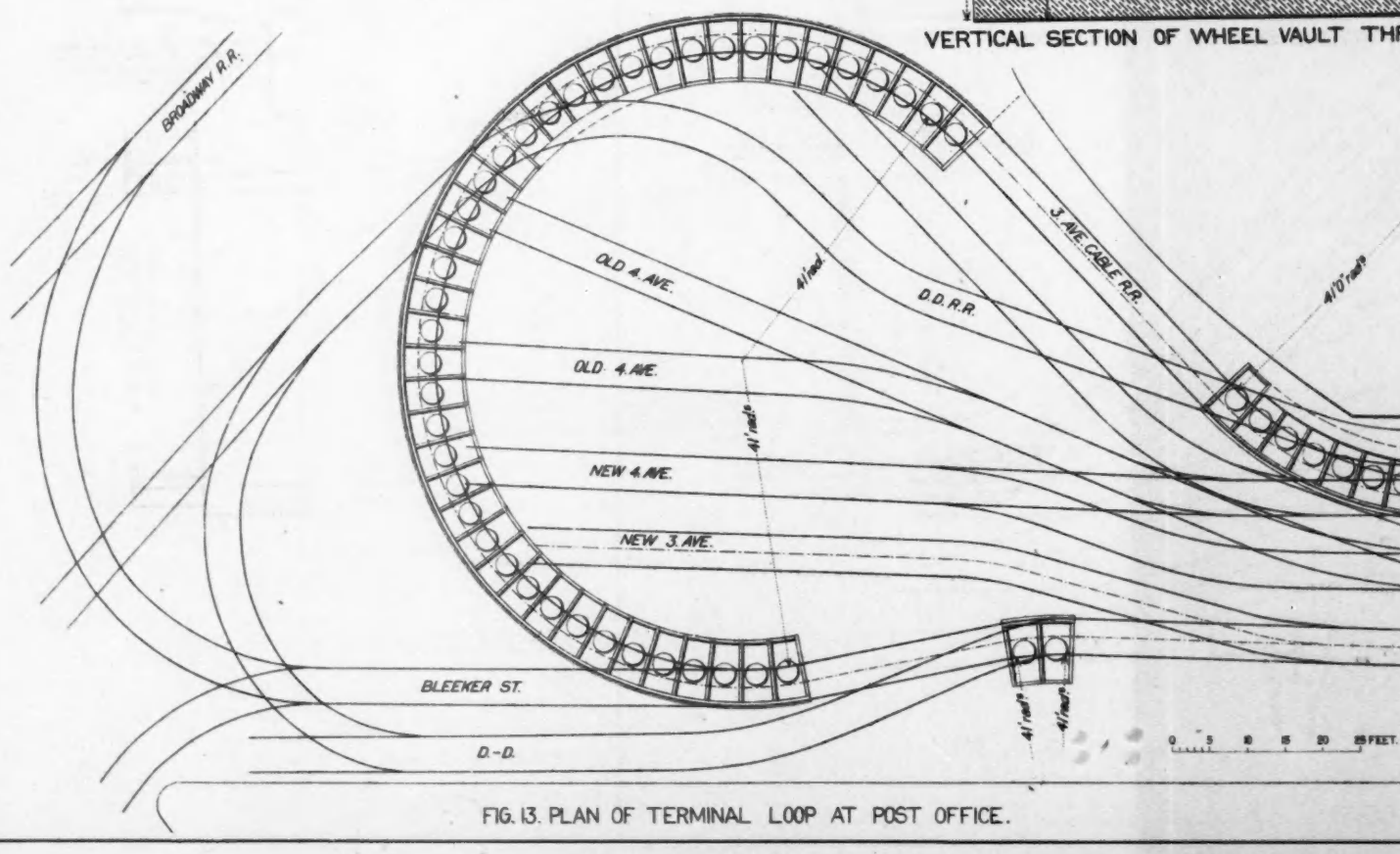
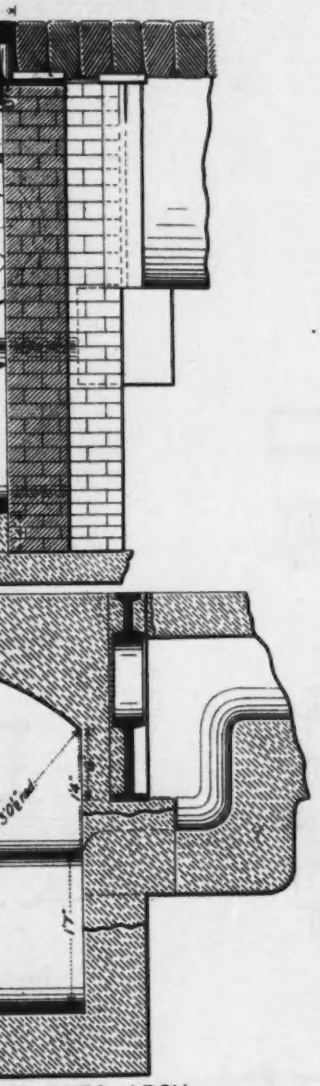
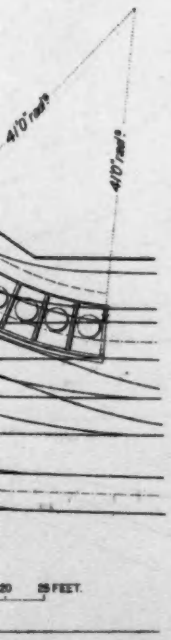


FIG. 13. PLAN OF TERMINAL LOOP AT POST OFFICE.

THRO. MANHOLE.



LT THRO. ARCH.



20 25 FEET.

CHAS. HART & SONS, LITH., 30 VESEY ST., N.Y.

seems an important fact that, while one candidate explicitly pledged himself to devote his entire time to the Society's service, if elected, as a condition of nomination, his opposing candidate has publicly declared to various members within the past week that he will still feel himself at liberty to devote a certain amount of his time (to be determined necessarily by his own sense of the fitness of things) to outside professional practice. What that would mean in the future we may judge of from the past.

Twenty Years of Spanish Railway Practice.

The *Revista de Obras Publicas* for 1890, publishes a tabular comparative abstract of the workings of the railways of Spain, confined, of course, to the main items only, but embodying in small compass records which it would involve great labor to collect. As an indication that it is not the railway in itself, but the use made of the railway by a progressive people, which has been carrying forward so rapidly this country and those of northern Europe in this period, the table has no small interest. It is difficult to see how the railway can have had in any country so little stimulating effect as it has had in Spain.

The Spanish railway system to be sure, is small, and so could not be expected to greatly affect the life of a people, but this is because it has persisted in remaining small, instead of one railway leading to the construction of others, as in more favored lands. At intervals of five years its length in miles has been as follows, adding the figures for England and the United States for comparison:

Spain.	1867.	1872.	1877.	1882.	1887.
Length, miles.	3,206	3,416	3,986	4,633	5,719
Incr., "	....	210	570	647	1,086
Great Britain.					
Length "	14,247	15,814	17,077	18,457	19,578
Incr., "	....	1,567	1,263	1,380	1,121
United States.					
Length, "	39,250	66,171	79,088	114,713	149,913
Incr., "	....	26,921	12,917	35,625	35,200

It will be seen that the Spanish mileage has taken somewhat of a spurt lately, but it is still very small. The inhabitants per mile of railway in 1887 (taking the 1880 figures for population) compare as follows:

Spain	2,840 inhabitants per mile of railway
Great Britain	1,670 " " " " "
United States	337 " " " " "

The passenger traffic on the Spanish railways has remained all but constant, having been in *number* of passengers (not passenger miles) 1,240 per mile of road in 1867, 1,360 in 1872, and only 1,370 in 1887. In Great Britain, during the same period, the number of passengers per mile increased from 20,200 to 37,450. To determine the same comparative figures for the United States would involve much labor, and the result would be of little worth for comparison, since the great question of comparative haul is not included. The increase here has certainly been large.

In total number of tons carried, regardless of haul (which again we note is a wretched unit, but the only one possible), Spain, Great Britain and seven Eastern* and six Western† trunk lines of the United States compare as follows:

	TONS OF FREIGHT.				
	1867.	1872.	1877.	1882.	1887.
Spain	2,836,900	4,770,721	6,548,087	9,398,582	9,807,690
Gt. Brit.	147.....	184.....	.....	256.....	203,926,884
U. S. t'k lines E	15,594,454	28,634,347	36,133,676	64,945,092	84,754,298
U. S. t'k lines W	6,303,783	10,592,414	13,364,721	29,851,898	40,276,906

[The figures for Great Britain, left partly blank, are close approximations only. The haul in the United States is several times longer than in Great Britain.]

It will be seen that even in Spain there is some tendency for freight tonnage to increase, but that the increase is very slow, and has lately almost stopped. The total traffic is quite insignificant, the haul being certainly short, although we cannot give its exact length; and the traffic per mile of road has not even quite doubled.

*The Pennsylvania, Pittsburg, Ft. W. & Chicago, N. Y. Central & H. R., Lake Shore & M. S., Michigan Central, Boston & Albany and N. Y., Lake Erie & Western.

†The Chicago & Alton, Chicago, Burlington & Quincy, Ch., Milwaukee & St. Paul, Ch. & Northwestern, Ch., Rock Island & Pacific and Illinois Central.

The average number of trains over the road has even been decreasing during the last 10 or 15 years, due probably to the recent spurt in new construction to which the traffic does not respond. The average number of trains per day each way has stood as follows:

1867	1872	1877	1882	1887
3.36	3.51	4.69	5.47	4.11

That the condition of the Spanish railways is unprogressive is indicated by nothing more clearly than by the fact that the percentage of profit to gross receipts steadily increases, and the percentage absorbed by expenses steadily decreases. The receipts, expenses and net receipts per mile of railway have varied as follows:

	1867.	1872.	1877.	1882.	1887.
Receipts	$5,090	$6,040	$6,950	$7,280	$6,300
Expenses	2,680	3,575	3,080	3,370	2,780
Net receipts	$2,410	$3,465	$3,870	$3,890	$3,520
P. c. expenses	52.74	42.45	44.28	46.65	44.03

It will be seen that the earnings have increased about as rapidly as the traffic, which is chiefly passenger, indicating that in all this period rates have remained very nearly stationary. We regret that we have no data before us from which can be determined even approximately the average rates per ton mile or per passenger mile. The total number of passengers is more than twice as great as the total number of tons, the disproportion in Great Britain being still greater. The ton and passenger mileage is about the same in Great Britain, however, and probably in Spain also, the average haul being much greater on freight than on passengers.

The average earnings per train mile have been from the beginning, and are now, a little less than $2.00 per train mile; and the average expenses per train mile, which stood twenty years ago at about $1.00, have now fallen to 75 cents. In detail these two records stand as follows:

Receipts and Expenses per Train Mile.	1868.	1872.	1877.	1882.	1887.
Receipts	$1.92	$2.18	$1.82	$1.55	$1.94
Expenses	1.01	0.93	0.80½	0.68½	0.75

Taking all things together, it seems clear that it is beyond the power even of the railway to galvanize the Spain of to-day into a new life. The United States, Great Britain and Germany seem to monopolize the tendency to very rapid material progress, the United States having much more than Great Britain (though perhaps no more in proportion to opportunity for material progress), and the English-speaking countries, as a whole, much more than any other nations, and vastly more than the nations of Southern Europe. If we may assume that existing tendencies will continue as they are it needs no prophet to foresee what will be the industrial conditions of the civilized world within the next half century. All its important material interests, barring a very small fraction, will be controlled by the English-speaking race, and the greater part of them by this continent.

The Interstate Commerce Commission's Report.

The fourth annual report of the Interstate Commerce Commission, for 1890, advance sheets of which have been sent out, is devoted chiefly to a discussion of the infractions of the letter and spirit of the Interstate Commerce law during the past year. The attempts to work upon public opinion with a view to the possible repeal of the law have been less numerous. The railway companies have accepted the situation and concluded that the law is here to stay, and they had better make the best of it. But while to outward appearances the law has been observed in the main, wherever competition has been especially active railway officials have exercised their ingenuity to find ways to evade the law, and steal traffic from their neighbors by secretly cutting rates. The provision that rates should be published and filed with the Commission has been frequently ignored. The Commission attempted to obtain the aid of the railway traffic associations in securing the observance of the law; but they soon discovered the not very surprising fact that while the 68 associations now existing "have in view laudable purposes, their combined efforts exert little if any influence upon carriers in preventing rate wars and securing observance of the law."

As an excuse for the lax enforcement of the law the Commission gives statistics: 160,000 miles of railway, 700,000 employees, one million—or nearly one-twelfth the adult male population of the country—connected directly or indirectly with railway affairs, 540,000,000 tons of freight and 472,000,000 passengers carried annually. What wonder that five men find the work of regulating—revolutionizing this vast industry and wiping out abuses of long standing too hard for them. What wonder that urgent calls in different directions necessitate the leaving of many duties undone. Be it remembered that the enforcement of the laws is one only of the duties which the statute specifically requires the Commission to perform.

In view of these facts the Commission asks for power to delegate its authority in appointing agents to conduct investigations wherever needed, with power to call for the records and papers of carriers. Another hindrance to the Commission's work is the fact that traffic within the bounds of a single State is not considered subject to the law. A carrier may give rebates to a favored customer on his local shipments to influence all his shipments to other States. Laws in conformity with the Interstate law should be passed by every State legislature; but it is not likely that this will be done at present, unless indeed, the Farmers' Alliance takes hold to put the reform through.

Another interesting feature, which would be laughable were not its consequences so serious, is the way in which the railways hang together. They will fight like cats and dogs among themselves, but not one will call on the Commission for aid to punish his adversary any more than school boys would ask the teacher to interfere in their battles. Still, it is a rather deeper cause than "family pride" that makes the railways cover up each other's offenses as far as the Commission is concerned. Any railway which should haul up a rival before the Commission and charge it with having secretly given lower than its published rates to large shippers would stand a chance, not only of getting licked by the party peached upon, but of being "sent to Coventry" by all the shippers, little and big, for interfering with a railway which charged lower rates.

Another most discouraging thing is that when the courts were appealed to by the Commission to enforce one of its recent orders, which the railway company refused to obey, the judge ignored entirely all the Commission's proceedings, and opened the whole question anew, deciding finally, and as it appears most unwisely, to annul the Commission's order. Even worse than this, however, was the manner in which the judge in question tended to upset all settled standards of interpretation of the Interstate law. He ruled, for instance, that the only passenger rates subject to the law are those for single passengers.

The Commission reviews at much length this interference of the courts with the Commission's work. The matter of "reasonable rates" is taken up and the quandary is pictured in which a judge would find himself who should attempt from his limited means of observation to decide whether given rates were reasonable or not. The conclusion reached is that fixing of rates must be left to the railways themselves, leaving their reasonableness open to investigation by the Commission only.

The report reviews the work of preparing and establishing a uniform classification, which was finally completed last June by the delegates from railroad associations representing all sections of the country except the Pacific States. It is expected that the new classification will go into effect early in 1891. The Commission asks shippers

to be patient while the new classification is being put in force. Some injustice and inequality will be unavoidable. On the whole, however, it is believed that the advantages of uniform classification will soon be universally acknowledged.

Some complaint as to the working of the long and short haul clause continues to be heard, but has been much less than in preceding years. The Commission makes an excellent defense of this provision, and shows how much that has been said against it has been based on a wholly untrue conception of facts. In this connection the need of bringing State legislation into harmony with Interstate is alluded to. A queer example of the subterfuges under which the long and short haul clause is evaded is told. Last August there was a rate war on traffic from St. Louis to competitive points in Texas. The fighting roads dropped their through rates to less than half their local rates, claiming that the extraordinary competition justified their disregard of the law, a claim which the Commission promptly disallowed.

The Commission again aims some well directed blows at the two evils of ticket brokerage and ticket commissions. It estimates that $1,000,000 per annum of passenger receipts is diverted to the ticket brokers' pockets. In an appendix the Canadian law and several State laws prohibiting ticket scalping are abstracted. The amount of money spent in ticket commissions is still greater. Eight roads alone report an expenditure for ticket commissions of $812,884 in 1888. Legislation to prohibit and punish both these practices is again asked for.

Another amendment to the law recommended is one obliging through rates and through routes to be formed by common carriers upon request of any other common carrier. The provision is believed to be for the interest of both the public and the railways. It is further recommended that the tenth section, which provides fine and imprisonment for certain infractions of the law, be amended to make the provision regarding fines applicable to the offending corporation instead of its officials.

Recommendations for amendments contained in the third annual report are repeated concerning the obligation of witnesses to appear before the Commission, providing for the free carriage of persons injured in railway accidents with physicians and nurses, and of the actual families of employees without infraction of the law; also providing for the regulation of car mileage payments. It is also asked that the Commission be given authority to require reports of new construction, earnings and expenses from the railways at more frequent periods than once in each year, and that all companies doing transportation or terminal business in connection with railways be required to report to the statistician.

As a whole, the work done by the Commission must be admitted to be wonderfully good and satisfactory, and with each succeeding year the probability of their recommendations being acceded to and their power strengthened at weak points grows stronger.

CORRESPONDENCE.

Panel Concentrations Due to Engine Loads.

NEW YORK, Dec. 7, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: It seems strange that Mr. SZLAPKA should labor at such length in your issue of Dec. 6, to deduce unnecessary formulas or construct an elaborate discussion upon an obvious principle, without apparently recognizing the principle itself.

The diagram moment *at any point* is equal, of course, *to the momentum of all the concentrations*, on left of the point.

No formula is needed, but the simple expression of this principle in symbols will give a better one than Mr. SZLAPKA's without any discussion whatever.

Suppose we want to find the concentration at the fifth panel point: Then at once, If *all the panels are unequal*, and R_1 stands for the first concentration already found, R_2 for the second, etc.. M_5 for the moment of all wheels on left of fifth panel point with reference to last wheel, $\Sigma W_6 a_6$ the sum of all these wheels multiplied by distance from last wheel to sixth panel point, we have the diagram moment $M_5 + \Sigma W_6 a_6$.

Apply this same principle to the concentrations and we write at once:

$$R_5 = \frac{M_5 + \Sigma W_6 a_6 - [R_1 l_1 + (R_1 R_2) l_2 + (R_1 + R_2 + R_3) \frac{l_3}{l_5} + (R_1 + R_2 + R_3 + R_4)(l_4 + l_5)}{l_5}$$

So for any concentration.

If all the panels are equal we have at once

$$R_5 = \frac{M_5 + \Sigma W_6 a_6}{l} - \left[5 R_1 + 4 R_2 + 3 R_3 + 2 R_4\right]$$

so for any concentration.

The working of this requires less figures than Mr. SZLAPKA's expression.

No one needs a formula. It is only necessary to find the diagram moment at any panel point, and then substract the moments of the concentrations already found. These last are written at once from inspection, the panel lengths being known.

It seems strange that any one should think this a subject for investigation, or the results of special interest. It is more strange that he should make such an investigation and not notice the uselessness of it. Still more so, that he should call the multiplying of each load by its distance from right and left abutment respectively, the "usual way."

If this has been the usual way with Mr. SZLAPKA it would seem to indicate that he has not grasped fully the very principle upon which his own diagram is based and used.

Why go through two columns of mathematical reductions and demonstrations in order to declare a self-evident result, which any one can write down off-hand without any demonstration at all, and which no one has use for after it is written down?

D.

Corrosion of Pipes by Sea Water.

OLYMPIA, Wash., Dec. 1, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Permit me to inquire through your columns what has been determined from experience to be the best pipe for a fresh water main, laid in or beneath salt sea-water, economy in first cost, facility in laying and durability considered. Also, is there competent experience tending to show that iron pipe will suffer an appreciable difference of deterioration from the external action of the sea water of the Atlantic and Pacific coasts? The latter point is one upon which I would especially seek the information of experience.

Very truly, A. W. HARDY, C. E.

[Long lengths of riveted steel or wrought-iron pipe, well protected by tar or asphaltum, are most easily handled in average work of this nature. For durability under ordinary circumstances cast-iron is probably better, and in comparatively shallow water is readily sunk. We would refer Mr. HARDY to some interesting papers on this subject by Mr. THOMAS ANDREWS and others (Transactions Institution Civil Engineers, Vols. LXV., LXXVII. and LXXXII.) Mr. ANDREWS discusses both simple corrosion and galvanic and electric action in steel, wrought iron and cast iron immersed in sea water. His conclusions, however, are not very definite as to relative results, though he says they all corrode badly, steel somewhat faster than wrought iron, owing, perhaps, to its more complex internal structure. ROBERT MALLET has published much on the corrosion of cast and wrought iron in sea water (Inst. Civil Engineers, Vol. II.). TRAUTWINE, in his "Pocket Book," gives some practical points in the same direction. HENRY MARION HOWE, in "The Metallurgy of Steel," treats of the comparative corrosion of steel and wrought iron in fresh and salt water and sewage. Of the difference in action of water from the Atlantic and Pacific Oceans, we know nothing.—ED. ENG. NEWS.]

True Meridians as Alignment Checks.

ROANOKE, Va., Dec. 5, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I wish to call attention to what seems to me to be a very useful but little regarded practice in field work, namely, the establishment of true meridians in location and right of way surveys.

The usual practice of assuming a magnetic bearing and using this to run calculated courses from seems to be a poor substitute for correct bearings of calculated courses. The necessity for these true bearing lines along a great railway system, lined with growing towns, grows as the value of its own land and adjacent land increases. With but a few extra hours' labor the engineer may make these lines definite and exact for all time.

I have been accustomed to establishing true meridian lines on location and right of way surveys every 10 or 15 miles, and find them a most excellent check on alignment angles, a point, by the way, that the field books ignore.

Very few engineers would think of running a construction line of levels without check, but how many location surveys have a check on alignment. A true meridian, established every 10 miles, furnishes a perfect and absolute check on alignment, and is easily and quickly established without delaying the party.

The magnetic courses used as check on angles are but poor checks at the best, and do not invariably discover an error of from 1° to 2°, especially in iron ore districts, and on track surveys, unless offset bearings are taken.

The methods of determining true north and south lines are given in every field book, and it is only necessary to connect such a line with the nearest tangent to determine its true bearing exactly. There is always likely to be some difference due to error discovered, and this difference should be proportioned among the angles laid off since the last check and the courses recalculated.

In the determination of these meridians I have found a state atlas or a good map to give the latitude accurately enough for all practical purposes.

G. WHITEFIELD CHANCE,
Resident Engineer, N. & W. R. R.

[All really good transit work on long railway lines everywhere is done with constant checking of the angular work by the needle, which with care can always be made to insure against single errors of ½° or more, the errors most likely to occur. Even where local attraction exists, if it be not due to something about the instrument or the persons standing near it, the needle will remain stationary while the instrument itself revolves, and so will check the angle laid off at any point.

For this reason it is the general opinion, we apprehend, that the computed bearings used during the progress of the survey had much better be magnetic bearings. The survey may then be checked at any moment by dropping the needle, since the computed and magnetic bearing should always correspond; nor does this in the least impede that more exact checking every few days by determining the true north, which our correspondent recommends, and which every one will approve of, though he is correct in saying that it is not practiced as much as it should be. Thus, if the algebraic sum of the angles laid off on 10 miles of line is 20° to the right, and the angles with two true north lines show the true algebraic sum to be 20° 10', what difference does it make as respects the necessary corrections whether the recorded computed bearings are magnetic or true? The better practice in our judgment is to use computed magnetic bearings for record, but to record with them the true variation at frequent intervals, so that the true bearing of any tangent can be determined very readily if desired. It rarely happens that railway tangents can be laid off in the beginning to give some even bearing.—ED. ENG. NEWS.]

Notes and Queries.

CORRECTION.—"Holding Power of Drift Bolts." In the communication of Mr. J. N. Sturm, in our issue of Nov. 29, a typographical error makes him speak of "bolts 2 in. square, driven, etc." It should have read "1 in. square.'

CORRECTION:—"Stability of Lighthouses." Mr. E. Schmitt calls our attention to several misprints in his article of Dec. 6. In the second condition, obliquity of pressure is 5° *not* 50°. As to the third condition, cancel the words—"is so little as," and read "and this only if." At end of explanation of Fig. 2 read "joint" A B, instead of "point" A B. In same, read point "q" and not "g.' The marks sub. 1 at some of the letters are commas only.

Narrow-Gauge Compound Locomotives.

The accompanying engraving is from a photograph of a locomotive built by the Baldwin Locomotive Works for one of the government railways of Brazil. The principal dimensions of the engine are as follows:

High-pressure cylinders	9 ins. × 18 ins.
Low-pressure cylinders	15 ins. × 18 ins.
Driving wheel diameter	37 ins.
Total wheel-base	18 ft. 2 ins.
Driving-wheel base	11 ft. 4½ ins.
Total weight	62,000 lbs.
Weight on drivers	53,000 lbs.
Boiler diameter	48 ins.
Fire-box: length, 79 7-16 ins.; width, 27¾ ins.	
Tubes: No. 126; diameter, 2 ins.; length, 10 ft. 1¼ ins.	
Tender capacity	1,600 galls

The small diameter of the driving wheels makes it convenient to place the high-pressure cylinders underneath the low-pressure cylinders, instead of

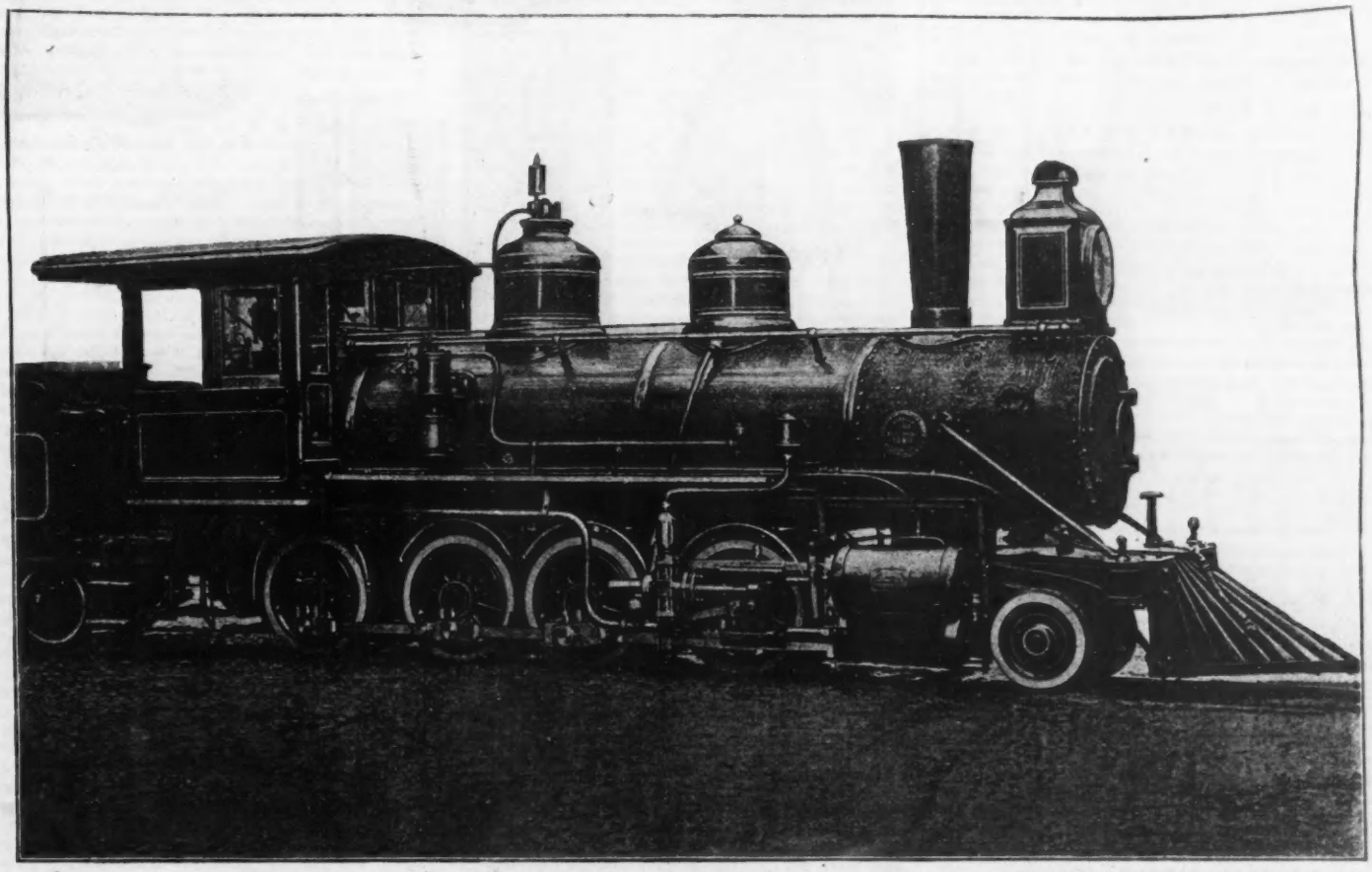
above, as has been the custom with standard gauge locomotives of the Vauclain type. By this construction the cylinders are but little closer to the rails than in ordinary consolidation locomotives.

It will be remembered that in the report of the tests of the Baltimore & Ohio compound locomotive, made by Mr. GEO. H. BARRUS (ENG. NEWS, Sept. 6 and 13), some changes in the dimensions of the ports and steam passages were recommended. These recommendations have been followed in the design of the compound locomotives constructed since the report. The engine illustrated has made several trips, and is reported as working perfectly. An ordinary consolidation engine which is now in the shops undergoing thorough repairs is soon to be put on the road, and the comparative economy and capacity of the two engines will be tested.

Another compound narrow-gauge locomotive has been recently turned out at the Baldwin Works for the Mexican National Ry. It is of the 10-wheel type. The gauge is 3 ft.; cylinders, 10 × 20 ins. and 17 × 20 ins.; driving wheels, 46 ins. diameter; total wheel base, 21 ft. 5 ins.; driving wheel base, 12 ft.; total weight, 74,000 lbs.; weight on driving wheels, 54,000 lbs.; diameter of boiler, 48 ins.; 132 tubes 2 ins. diameter and 11 ft. 9⅜ ins. long; fire box, 83⅛ ins. long, 24⅜ ins. wide, 55¾ ins. deep at the front and 44¼ ins. deep at the back; water space, 3½ ins. at front, 2½ ins. at sides and back; radial staying. The truck wheels are 26 ins. diameter, with journals 4¼ × 8 ins.; driving wheel center, 45 ins.; driving axle journals, 6½ × 7 ins. The tender is carried on two 4-wheel diamond trucks, with 30-in. wheels and journals 4¼ × 8 ins.; it has a capacity of 3,000 galls.

The Baldwin Works are also building for the Paulista Ry., of Brazil, three compound American type (8-wheel) passenger locomotives, equivalent to high-pressure engines with cylinders 16×24 ins., and a compound consolidation engine equivalent to a high pressure engine with cylinders 20×24 ins. For the Oeste de Minas Ry., of Brazil, they are building two narrow-gauge compound engines, one of the 8-wheel and one of the 10-wheel type.

It seems indeed strange that railway managers in the United States should be so much disposed to talk on the subject of compounding locomotives and so little inclined to introduce them in service. It may be taken as well settled that the fuel economy of the compound over the simple engine is from 10% to 25% in daily service. In all European countries, and even in Mexico and South America the compound locomotive is rapidly growing in popularity, and, as shown above, no less than seven American-built compound locomotives will soon be running in Brazil. No valid reason has yet been given why the compound locomotive is not as well adapted to American railways as to those in other lands; and though a beginning has been made by a few progressive men, it is undeniable that the introduction of the compound in this country is proceeding much more slowly than it ought. By this we do not mean that every railway in the country ought immediately to set about compounding its whole locomotive equipment; but that all the larger roads, especially those on which fuel is most expensive, should now be carefully testing in service one or two of each of the promising types of compound locomotive. The only apparent reason for the delay is the unsatisfactory one of mere inertia. But the railway men of this country have been generally supposed to be the most progressive in the world. They cannot long maintain this reputation, however, if so important and manifest an improvement as the compounding of locomotives is delayed until the change is practically completed in all other countries.



NARROW-GAUGE COMPOUND CONSOLIDATION LOCOMOTIVE FOR PERNAMBUCO EXTENSION, OF BAHIA RY., BRAZIL. BUILT BY THE BALDWIN LOCOMOTIVE WORKS.

Subaqueous Foundations.*

(*Continued from page 416.*)

Could the entire face of that quay wall have been rendered visible by the exclusion of the water, the defects exposed would have astonished most engineers, but as these defects are buried under water, only divers can possibly have a knowledge of the actual state of the work. From a conversation I had with General NEWTON in New York on the 23d of May, 1891, I was greatly impressed with his remarks on the best method of obtaining sound concrete work under water, and he was strongly of opinion that something should be done, if possible, to prevent the mechanical separation of the particles of cement, etc., under water, and I have, therefore, thought it might be of service to refer at some length to an example such as this, of the uncertainty of obtaining uniformly sound monolithic work by the deposition through water of freshly mixed concrete, and especially as to the difficulty of forming a hard, durable facing to the work, and filling up of angles or corners.

Various methods have been adopted to secure a good face to concrete work constructed *in situ* under water, but whatever course may be pursued, it is most judicious to use plenty of cement, and this is an absolute necessity when the soundness of the concrete facing is to be relied upon, for, as a rule, concrete as ordinarily deposited under water generally requires at least double, and even treble the amount of cement to make it equal in strength to concrete made out of water. At Aberdeen Harbor plastic concrete was used in December, 1881, and also in 1882-3 in connection with Provost JAMIESON'S quay of 600 ft. in length, and the quay walls of 900 ft. in length, inclosing the site of the graving dock, and which, I believe, has been successful, especially if I may judge from the excellent specimens sent me some years ago, which were chips which had been broken off from a corner of a block immediately after the frame or timber mold had been removed.

Instead of trusting to the formation of a sound facing by the deposition of concrete containing a large proportion of cement, other expedients in many cases have been employed. Thus, in the construction of the southwest pier walls of the tidal harbor at the James Watt Dock Works, Greenock—a section of which is shown at Fig. 8—I had the under-water portion of the wall, from the foundation up to 2 ft. above low-water level, faced with greenheart piling. This wall is 46 ft. in height, 28 ft. of which is under low water. The method adopted in its construction was to dredge a trench over the site of the work, to drive along the line of the face of the wall, and to the batter thereof, 14-in. square greenheart gauge piles, at distances of 7 ft. apart. Between the gauge piles 7-in. greenheart sheeting piles were driven, and the heads of the piles were cut of at 2 ft. above low water. These piles were connected together at their tops by a greenheart waling, with the necessary filling-in pieces. At intervals of about 6 ft. apart vertically 1¼-in. bolts of about 3 ft. in length were put through each pile, having tails several inches long, turned down at right angles in order to get a good hold of the concrete, and so prevent the piles from bulging out or separating from the facing concrete. At the back of the wall ordinary temporary lumber framing or shutters were used to retain the concrete in place until it was set. There were two classes of concrete used. Next the facing of greenheart piles, the proportions for 3 ft. in width of the wall were one of cement to three parts of coarse sand and finely broken stone, and for the remaining portion of the wall one of cement to six parts of

* By WALTER ROBERT KINIPPLE, M. Inst. C. E. Reprinted from *Engineering*.

sand and broken stone. From the tops of the piles to coping level the wall was faced with granite ashlar, and backed with rubble concrete.

In some instances a facing of cast iron has been adopted; thus, in 1832, Mr. Matthews used cast iron piles in lengths of 9 ft. by a width of 2 ft. by ¼ in. in thickness, in connection with the foundations of the north pier-head at Bridlington Harbor. After that year other engineers used them, viz., in London at the New River Head, and also on the Thames at the Broken Wharf. In 1824, in connection with the rebuilding of the return end of the quay wall of Down's Wharf, St. Katherine's, a wharf in the River Lea at Limehouse, another at the sea entrance of the Norwich and Lowestoft Navigation, and in the founding of the pier-heads of the basin of St. George's Dock, Liverpool, and other places down to the years 1833-34, when the Brunswick Wharf at Blackwall was constructed by Messrs. Walker and Burgess. The main piles of this wharf are 25 ft. 6 ins. in length by 11½ ins. on face, are pitched at 7 ft. centers, and driven 10 ft. The face metal was 2½ ins. in thickness, and the back ribs 1¼ ins. by 5½ ins. in depth. The spaces between the main piles were filled in with sheeting piles of 22 ft. in length, and were driven about 8 ft. into the ground, composed of coarse gravel and Blackwall band or rock, the latter of which occurred in patches along the line of driving. The upper portion of 11 ft. in height of the wharf, or between the tops of the sheeting piles and the under side of the coping, was faced with cast iron plates in three tiers between the main piles, which were carried up to coping level, and the whole facing from foundation to cope was backed with one to ten lias lime concrete, and coped with Devonshire granite. The wharf has a depth of 10 ft. at low water against its face, and its total height from the bed of the river is 32 ft. The length of the wharf is about 720 ft., and the weight of cast iron used is about 900 tons. This wharf, although 55 years old, is still in good condition, with the exception of a few broken piles and plates, and certainly up to the present time, even although these breakages have occurred, has answered well the purpose for which it was designed, viz., a passenger landing quay at a moderate cost. It may be regarded as a very good example of a work having a cheaply constructed face of a somewhat perishable material. Following this work, some years afterward, the wing walls of the Blackwall entrance to the Victoria Docks were similarly constructed.

Structures dependent on cast iron and exposed to the action of sea water, can only be looked upon, after from 30 to 50 years, as of a comparatively temporary character, and especially is this the case in regard to the very light cast iron pile structures erected as promenade sea piers at many of the watering places on the coast. The rapidly oxidizing action of the sea water upon such iron structures would seem to indicate that the time is not far distant when it will become an absolute necessity that an examination by a duly qualified Board of Trade inspector should be made of all the cast iron piers in the kingdom so as to satisfy the public that such structures can be relied upon during heavy weather.

At the Albert Harbor, Greenock, a facing of large slabs of granite, between cast iron piles, was employed below water. I have represented a section (Fig. 9) of that quay wall. The method pursued was to dredge a trench along the site of the wall, drive at distances of about 7 ft. apart cast iron double-flanged gauge piles, and slip down between the flanges of the piles rough faced granite slabs 7 ft. × 7 ft. × 2 ft. thick, but somewhat reduced at their edges next the piles to fit into the grooves between the pile flanges. The piles were driven to such depths that projections or ledges in the grooves between the flanges were level with the bottom of the harbor, and these ledges formed a stop or seating for the granite slabs to rest upon, so that the tops of the slabs by this means were kept at a uniform level, or very nearly so. The piles were tied back with wrought iron tie-rods. Behind the granite facing, Arden lime concrete was deposited by skips, and above low water level the wall was faced with sandstone ashlar, and backed with concrete. Many of the cast iron piles, although not much more than thirty years old, are now so soft that they can be easily cut by a penknife.

In the construction of a quay wall at Girvan Harbor I adopted for the portion below low water a facing of small concrete blocks of dovetail shape, 21 ins. in length and 12 ins. in depth (see Figs. 10, 11 and 12). The weight of each block was about 180 lbs. in air and about 100 lbs. in water, and was easily handled without a crane. The blocks were made of one part of Portland cement to four parts of sand and fine gravel, and their exposed faces and arrises were rendered with a coating ¼ in. in thickness of one to one Portland cement compo. Small semi-dovetailed grooves all around the outer or face arises of each block made (when the blocks were laid in position) complete dovetailed grooves with the adjacent blocks, which, as each course was laid, were caulked or filled up with canvas, clay, or quick-setting cement, thus forming the sides of a cement tight box or dam, within which the concrete backing was deposited up to about 6 ins. below their tops.

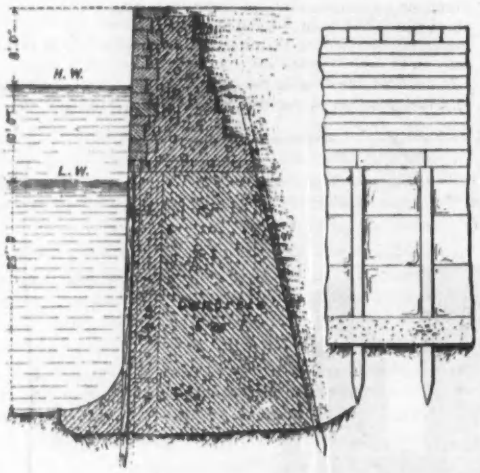


Fig. 8.

Fig. 9a.

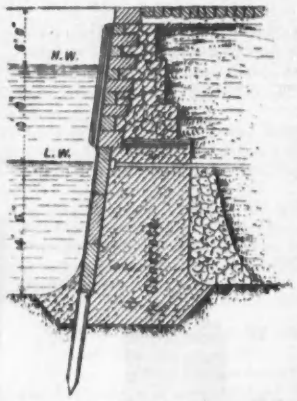
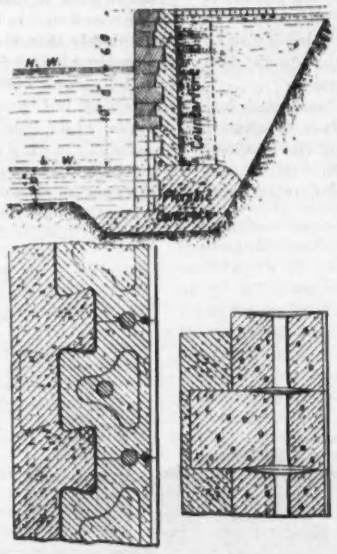


Fig. 9. Albert Harbor Quay Wall, Greenock.



Figs. 10, 11 and 12.

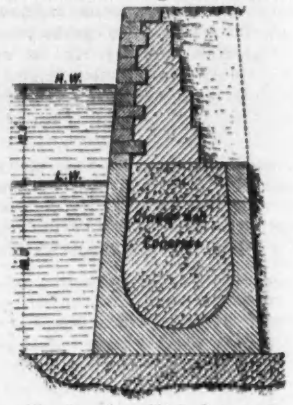


Fig. 16. Quay Wall, Greenock Harbor.

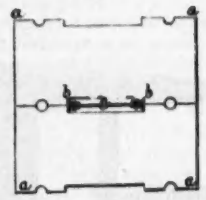


Fig. 21.

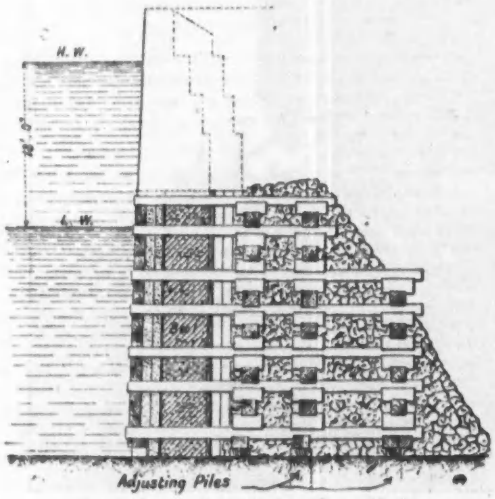


Fig. 13. Quebec Harbor Quay Wall.

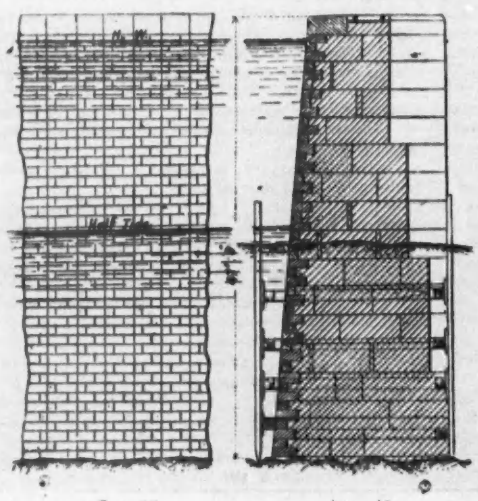


Fig. 17.

Fig. 18.

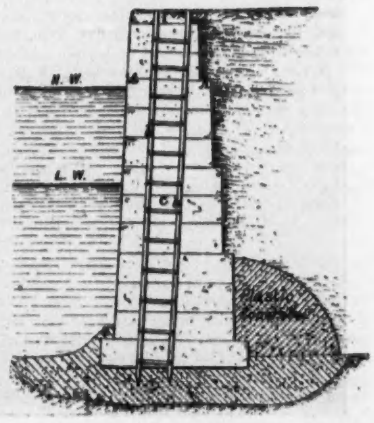
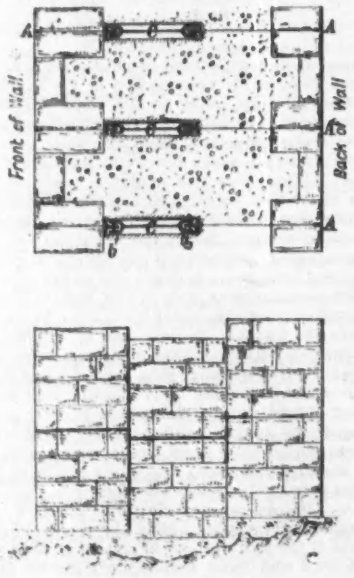


Fig. 20.



Figs. 22 and 23.

Thick cement grout was then poured down the centre circular holes and end joints of the blocks, when it flowed into the hollowed-out beds and the hearting, firmly cementing it to the facing blocks. In this manner a solid monolithic structure, with a durable facing of blocks, was constructed without the aid of timber frames or molds. The divers found no difficulty in setting, or rather stacking, the blocks one on top of the other, as fast as they could be lowered down to them.

In the construction of the quay walls in connection with the recent Quebec Harbor improvements, the circumstances under which work had to be carried on differed so much from the conditions in England that I had to adopt considerably modified arrangements in the execution of these works. The working season at Quebec is confined to about half the year, viz., from the middle of May to the middle of November, and all plant and temporary work must be removed at its close, as only very substantial work can possibly resist the very heavy abrasion of the sheets of ice from 3 ft. to 5 ft. in thickness, rising and falling with the tide from 16 ft. to 18 ft. Such being the case, I resolved to construct the 1,250 ft. lineal of the tidal harbor wall with cribwork, so formed as to contain a full section of a (concrete *in situ*) wall with the usual counterforts. The cribs were constructed early in the spring of 1879, 12-in. × 14 in. square baulks of timber being chiefly used for the purpose. These baulks were sawn to gauges, laid longitudinally and transversely, notched into each other and firmly bolted together at their intersections. Between May and November, 1879, the cribs (with the exception of the sawing of the timber) were all built, floated into position and sunk on to the tops of the heads of the bearing piles at 24 ft. below low water. The cribs were each 120 ft. in length, except the last or closing one, which was about 50 ft.; they were all 33 ft. wide at their bases, 23 ft. wide at their tops, and 27 ft. high. Their front compartments, which formed the usual and full section of ordinary quay wall, together with the counterforts, were filled from bottom to top with partially set Portland cement concrete in the following proportions, viz., the front 2 ft. of four to one of concrete and the remainder eight to one. The construction of the 1,250 ft. of cribwork complete, that is the building (partly aground and partly afloat) of the cribs, dredging for their reception a trench through sand of 28 ft. in depth, or to 24 ft. below low water, by 40 ft. in width at bottom, with flat slopes on each side resembling a wide railway cutting, driving bearing piles at bottom of trench with great accuracy for the reception of the cribs, sinking the cribs on the tops of the bearing piles, and filling up the compartments in the front of the cribs with concrete, and among the timbers of the cribs behind the compartments with clay, stone and sand, occupied only five working months being at the rate of one lineal foot of the complete wall up to 4 ft. above water per working hour, a most exceptionally rapid rate of progress for the execution of such works, and, as far as I know, is without parallel in subaqueous works. The tops of the cribs, when in position, formed part of the quay wall, and were at a level of about 3 ft. above low water. Above this level the wall was faced with ashlar and backed with Portland cement rubble concrete. This length of wall of 1,250 ft., 48 ft. in height, is founded on sand, and forms the southern side of the tidal harbor.

The works from first to last have stood the severest of Canadian winters without damage of any kind. A block of Portland cement rubble concrete similar in every respect to that which was being used in the harbor works, was placed at about half-tide level on the Custom House stairs alongside of a block of concrete in which a Canadian or native cement was used. These blocks were exposed for two or three winters to very severe frosts. The Portland cement block at the end of the test was found to be quite perfect and sound in every respect, while the native cement block had wasted and gone to pieces. Any of the concrete in the work between coping level and low-level and low-water mark, completed seven days before the winter first set in, showed a very slight disintegration, while that executed a fortnight or three weeks before the frost came was found to be absolutely perfect when uncovered in each following spring. I believe it was the first time any such work, under similar conditions, had been executed in Portland cement in Canada, and it is now used everywhere with confidence in that country.

In cases where a solid structure is required and a firm stratum can only be reached at a considerable depth, it is customary to resort to the use of caissons for sinking through soft strata. Caisson work has been very largely developed within the last thirty or forty years, and especially for founding piers of bridges over rivers and estuaries, where formerly foundations of bearing piles would have been employed. Brick caissons, however, are well known to have been used in India for well sinking and similar purposes from time immemorial, and the very modern practice of using concrete cylinders for founding dock walls is simply an extension of that system. Cast iron cylinders have been so largely used for the piers of railway and other bridges during the last 40 years, and are so well known that I hardly think it necessary to refer to them in detail. I may, however, mention that the cast iron cylinders (sunk in 1842) of the Terrace Pier at Graves. end were the first, I believe, used in Great Britain, and the next were those of Rochester Bridge, in connection with the construction of the piers. The larger class of caissons are usually formed of shells of wrought iron plates, riveted together, stiffened vertically and horizontally by angle, T or H irons, or built beams, or ribs, according to their sizes and the pressure to which such caissons may have to be subjected. Caissons may also be built of cast iron, timber, brick or concrete, depending much upon circumstances, locality, etc. In sinking a caisson it is usually necessary to add considerable weight, in order to overcome the friction of its outside skin against the strata through which it has to pass. One of the most convenient arrangements for adding the weights required in sinking is by building up a wall of concrete inside the caisson, next to the shell. If sufficient weight cannot thus be obtained, then temporary loading must be resorted to with cast iron stacked on the inside stringers or by railway bars laid on the top, which weights are removed and added from time to time as the sinking proceeds, and further rings or stakes are added. During sinking, great care is required in order that the caisson may be kept vertical, for if once allowed to get even slightly out of plumb, it is difficult and sometimes impossible to get it back into position, or even nearly so.

At the commencement of the construction of the Thames Embankment, adjoining Westminster Bridge, cast iron caissons were employed in the first instance to serve as a cofferdam, so that the embankment works should be executed dry, but these were abandoned owing to the great difficulty of sinking them with the accuracy required for such a work. Elliptical wrought iron caissons were afterward tried, and were sunk close to each other; the joint between each end was to be rendered water-tight by a timber guide pile, or tongue, driven down a groove half formed in the ends of each caisson at the points where they adjoined each other. The lower portions of the caissons were to be left in the bottom to form a toe to the wall, and the upper portions above the bed of the river were to be removed on the completion of the wall. It was found, however, that the caissons could not be sunk so accurately as was expected, and, although the depth of strata to be sunk through was less than 20 ft., yet the caissons got so much out of plumb in that shallow depth that water-tight junctions between them could not be made, except at great cost and trouble, and the dam of caissons had, therefore, to be abandoned in favor of an ordinary timber double-pile dam with a clay puddle wall.

The largest and best known examples of caissons are those which have been recently employed in founding the piers of the Forth Bridge. They are upward of 70 ft. in diameter, and have been sunk, compressed air being used to depths of more than 70 ft. below high-water level. Greater depths than these have been reached in a number of instances with open caissons and cylinders of smaller sizes.

Another application of caissons has been used for founding harbor and dock walls upon soft strata instead of sinking through such strata to a firm foundation. This method is also applicable for obtaining sound facing to subaqueous works, apart from the questions of foundations. I have represented (see Fig. 16) a design I proposed for some quay walls to be constructed on the Clyde in 1871, where the foundation was soft, and an extended bearing area was necessary. The method proposed was to dredge along the line of the wall a trench about 25 ft. in width, by about 6 ft. in depth, below the bottom of the harbor, to fill up this trench with loose rubble and broken stone to within a few feet of the level of the bottom of the harbor, and the top of this stone filling was to have been sprinkled or leveled up with fine shingle, without the aid of divers, to form an even bed on which to found the caissons. The tops of the caissons would have been about 2 ft. above low water, and above this level the quay wall was to have been built in the ordinary manner. The caissons were each to be about 40 ft. long, 18 ft. wide, and 22 ft. high, formed of brickwork in Portland cement compo, the sides and bottoms being about 2 ft. thick, divided by partitions and stiffened at the corners. These caissons would have been constructed in an adjoining graving dock, allowed to harden for a few months, after which they would have received a thick coat of pitch and tar, been floated out to the site of the works and sunk into position by allowing them to ground at dead low water and afterward water would have been admitted to prevent them from rising. These caissons had sufficient freeboard of themselves to serve the purpose of safe flotation without the assistance of pontoons. After they had been sunk in place the interiors would have been filled with sand or rough concrete, or each compartment could have been pumped out and the concrete filled in dry. The work, however, was not carried out at the time, and, subsequently, I substituted another and less costly design of greenheart timber. At Ardrossan Harbor, an arrangement similar to this in principle, although differing in number of details, was adopted in the construction of a portion of one of the piers, and served the purpose remarkably well.

I have already made reference to the manner in which the foundations of the new Victoria landing stage works at St. Helier's, Jersey, were executed, single pile half-tide dams having been adopted. In another part of the same harbor an extension of the north quay wall was carried out (see Figs. 17 and 18), a similar method being pursued in sinking down to the rock, and afterward in the construction of the wall from foundation to cope. In this case, owing to the limited area for carrying on building operations, the depth below the bottom of the harbor to which the foundations had to be carried to reach the rock, and the limited time of four or five hours per tide during which work could be carried on, the arrangements, both as regards economy and expedition, had to be such that that everything should be at hand and ready, so that the work might be carried on in the most expeditious manner possible. For driving the piles, a back and front or double leader pile-driving engine was erected, which traveled on rails laid down on the bottom of the harbor and had an under trolley frame, so that it could be moved transversely as well as longitudinally, and thus any necessary adjustment of the engine for driving the piles was obtained. The material to be driven through was composed of fine sand, peat, gravel and clay, with large stones interspersed. After the experience of the use of various classes and thicknesses of timber and forms of shoes, it was found that good sound pitch pine piles, 6 ins. in thickness and 9 ins. to 11 ins. in width, with heavy cast iron shoes, having stout wrought iron straps, gave the best and most economical results. Piles of less thickness, or of greater breadth, did not stand the heavy driving through the hard, compact sand and clay. Thicker piles, or hard wood piles, could have been used, but the cost of the work would have been increased. The inner and outer rows of the sheeting piles were waled and strutted, as the excavations proceeded, with whole timbers, 12 ins. to 14 ins. square, and the frames were spaced from 5 ft. to 7 ft. apart vertically, according to the depth below the surface of ground and the pressure to which they were subjected. For draining these trenches of water, two pulsometer pumps were used, throwing jointly about 400 tons of water per hour, steam for which was supplied from boilers on board a barge grounded near to the trench. The pumps were suspended from a crossbeam over the trench, and were shifted by the crane from one trench to another as the works progressed. The excavation of the trenches was chiefly done by pick and shovel, the material filled into skips, and raised and deposited behind the finished end of the wall by a 10-ton crane, seated on the last built portion of the work constructed. Excavation by grabs was tried, but owing to the limited space for working between the struts and the danger of laying hold of and pulling out or disturbing some of the timbers, work could only be done in the middle of the trench without touching the sides and corners, and it was found, upon the whole, that the excavations could be done more cheaply and satisfactorily by hand labor than by grabs.

When the rock had been laid thoroughly bare a leveling of fine concrete up to a fixed height corresponding with the bed of the first concrete block was laid down, and on the top of this the wall was built up to the coping with blocks of rubble concrete 3 ft. × 3 ft. on face and varying in length from 4 ft. to 8 ft. These blocks were built in a work yard near to the works, allowed to set until thoroughly seasoned, then placed on trolleys and run on a line of rails laid on the top of the completed portion of the wall out to its end where the work was in progress. The face blocks had a facing of granite ashlar 11 ins. in thickness, with headers from 2 ft. to 2 ft. 6 ins. long and set to 2½ to 1 Portland cement mortar. The hearting blocks were built of granite rubble and 5 to 1 Portland cement compo. The blocks were firm enough to bear handling when three days old, but were allowed to become thoroughly seasoned before being placed in the work. They were laid header and stretcher in the wall and bedded in 3 to 1 Portland cement mortar about ¾ in. in thickness. Vertical joints of 1 in. in width were kept between all the blocks; the outside ones were then stopped with Medina or quick-setting cement and all joints filled up with the mortar, composed of three parts of coarse sand and one of Portland cement. A single course of blocks of 3 ft. in height by 18½ ft. in length of the wall was built in a few hours, and the rate of progress of the whole was such that a 37-ft. length of wall, of an average height of about 47 ft., was built regularly per month, including pile-driving, excavating to a depth of 20 ft. below the bottom of the harbor, and the building up of the wall from foundation to cope at an inclusive cost of £27 10s. per foot linear of the full section of the wall.

The wall was built in lengths of 18 ft. 6 in., which were so solid the day after the last course was laid, that the 10-ton traveling crane used in the construction of the work, and weighing over 22 tons, was moved on to the new work as each length was brought up, and not the slightest disturbance of work was occasioned thereby. As the wall carried the two lengths of movable platforms 18 ft. 6 ins. each and crane, the trouble and expense of erecting ordinary staging were avoided. The crane, at each shift forward, lifted from its rear and laid down in front of itself one of the 18-ft. 6-in. lengths of platform and staging complete, in about half an hour, and was then traveled forward to its extreme end, ready to command another length or section of the wall. Each length contained a counterfort, which was found of great use in carrying the shifting platform. The gauge of the rails on which the crane traveled was 12 ft. A system such as this of executing work is highly preferable to the deposition of

concrete through water, as there can be no doubt in regard to the soundness of the whole of the work, for a hard and perfectly durable face, either of granite or other material can be obtained, and the work can be expeditiously carried on with but little plant and, in the majority of cases, at an exceedingly small cost.

The blocks, instead of being brought up in vertical courses, as shown in Figs. 17 and 18, might be built in sloping courses, but this, as also the sectional lengths of the wall so brought up at one time, must necessarily depend upon the outreach of the crane. In the wall I have just described the length of section was covered by a clear outreach of 18½ ft. from the end of the last finished portion, or 26 ft. from the center of the crane.

On March 22, 1889, I reported to the Greenock Harbor Trustees on the best method of founding the proposed northwest pier of the western tidal harbor at Garvel Point, when I recommended a method of construction such as that shown by Figs. 20 and 21, and which consisted of blocks formed for the full width of the wall (see Figs. 22 and 23), the joints *a a a a* being vertical and quite close from foundation to cope. The guides *b b* (see Figs. 20 and 21) were to have been of iron, pointed at their feet, and having parallel bars or rungs, so that by raising one leg the other easily followed, when both would have been removed; and the spaces *C C C* would then have been filled in with stones and grouted up, or filled with fine concrete after the outside vertical and bed-face joints had been caulked.

(To be continued.)

A German Method of Repairing Wet Arches and Abutments.

In a recent number of the *Centralblatt der Bauverwaltung* was an account of a very satisfactory method of repairing damp tunnel arches, employed on the Trier division of the Prussian State Railways by Herr BLUM, the author of the article, from which we make the following abstract.

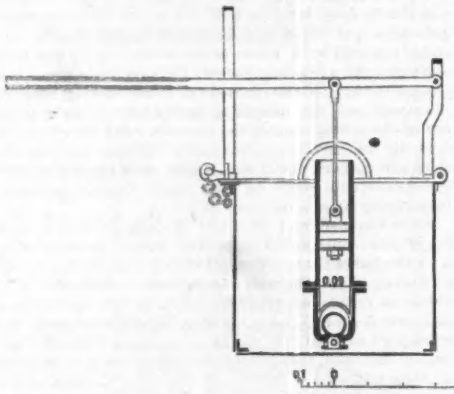


FIG. 1. FIG. 2.

The plan of the work was very simple, being merely the injection of cement through cracks and holes in the masonry, which became practically a monolithic mass as soon as the cement had hardened. This method of drying a tunnel was never employed until a careful examination of the surface of the ground had been made, and it was found impossible to remedy the faults by draining.

Where drainage will not suffice, the tunnel walls are carefully examined, and all joints not tight are scraped out to a depth of 2 ins. and calked with about four-fifths of an inch of oakum, and the remaining void filled with cement in the usual manner.

At the same time that this work is being done workmen are boring the 1½-in. holes through the masonry into which the current is to be injected. This cement is intended to fill not only the outer parts of the joints, but also to cover the whole exterior of the masonry if there are air spaces about it. As the work of boring these holes is expensive, care should be taken that they are driven at the most advantageous points. Experience has shown that a distance of 3 ft. between the holes is as great as is consistent with good results; in very wet places this should be reduced by a third.

Whether the holes are best driven through the stone or in the joints depends entirely upon the nature of the arch, especially the character of the stone, and must be determined independently for each case. Where soft stone is employed, it is generally better to drill through the voussoirs, especially if their faces were not dressed flat, since the holes through the joints will be very rough and uneven in such cases, and the additional labor in injecting the cement will more than counterbalance the slight saving in boring.

The semi-fluid cement that is forced into the crevices is composed of 5 parts of cement and 4 of water. The injecting pumps are shown in Figs. 1 and 2. The pump barrels are of brass and the nozzle at the end of the rubber pipe is copper. The price of the apparatus with 10 ft. of 2-in. rubber pipe was about $42. With a wooden tub the cost would be considerably less. The cement must be carefully stirred, and it is necessary to clean the pumps thoroughly at least once every day.

The cement is injected at the crown first by thrusting the copper nozzle through the oakum calking and pumping until the material shows in a neighboring hole or joint; whenever the cement appears in the joints, the openings are carefully plugged, the pumps stopped and moved to the next hole. The work is usually done by means of scaffolding mounted on wheels running on the track in the tunnel.

As soon as the crown has been made impervious the sides of the tunnel become damp. This is best remedied by breaking small openings through the tunnel sides and making, if possible, small drains filled with stone up toward the crown on the outside of the masonry.

The cost of the work varies greatly with the condition of the tunnel, as may be seen from the following figures.

The Heinzkyller tunnel is constructed of sandstone masonry and was very wet for years. The interior was rendered dry by injecting cement over 2,425 sq. yds. of tunnel surface at a cost of $2.45 per sq. yd. This sum includes the cost of constructing drains. In the Metterichter tunnel the cost of the work, not yet completed, has averaged $3.13 per sq. yd. In the Looskyller tunnel, 4,656 sq. yds. were improved at $1.56 per sq. yd. In the Nitteler tunnel, 2,830 sq. yds. were made dry at a cost of $2.87 per sq. ft.

Cost of Stone Dressing.*

In hard limestone, such as quarried at Alton, Ill., for rough bush-hammered work, the stonecutter receives 25 cts.; for medium work, 30 cts., and for fine work, 35 cts. per ft.

The Wallbaum Stone Co., in Henderson Co., Ill., does scarcely any other but ¼-in. joints, for which is paid, for plain work, 50 cts. per ft.

The Kankakee Stone & Lime Co. do only hand work. They say "with wages at $3 a day the cost of dressing limestone (bush-hammered or drove-work) is about 25 cts. per sq. ft." At the Southern Illinois Penitentiary where only hand work is done the cost of dressing from the rough is about 60 cts. per ft., face measure, for limestone; but if drove all over, about 80 cts. for limestone and 60 cts. for sandstone.

The actual cost of dressing such limestone as is quarried at Grafton, Ill., is $4.50 to $5 per cu. yd. for bridge stone, and from 18 to 20 cts. per sq. ft. for bush-hammered work.

The cost of sawing Bedford stone is about 20 cts. per cu. ft. The cost of quarrying is also about 20 cts., and the cost of cutting depends upon the price of labor—stonecutters' wages varying from $3.50 to $6 a day.

Machine Work.—The introduction of machinery for sawing and cutting stone during the last 30 years, and its improvement during that time to its present perfection, as well as the rise of stone cutters' wages in the last 30 years (fully 100 per cent.) are the factors which make the difference in dressing between the two systems of 65 per cent. on present conditions.

The Young & Farrell Diamond Stone Sawing Co., of Chicago, classifies the material into three grades, viz.: soft, medium and hard. The term soft would include all sandstones; medium, limestone—magnesian and oölitic; —and hard, marble and granite. The cost of sawing soft would average from 8 to 10 cts.; medium from 13 to 17 cts., and hard from 25 to 30 cts. per sq. ft., on the basis of 4 ins. sawing, or two cuts, to the cubic foot. The cost of planing the stratified limestone, as it is found in Illinois does not exceed 12 cts. per sq. ft. The cost of hand dressing the above stones is as follows: Soft from 25 to 35 cts.; medium 40 to 45 cts., and hard from 75 to 80 cts. per sq. ft. of clear face work, the price of labor estimated at the rate of 50 cts. an hour, which is the rate paid in Chicago at the present time. The cost of "hard," in which granite is included, is considerably less in the Eastern seacoast States, as the wages of granite cutters are only about half of those quoted above. No regular system of estimating on moldings or other irregular work in the two before-mentioned grades is in use, as the cost of such work depends largely upon the contour of the face and its projection from the wall, but ordinarily is about twice the cost of plain work. In granite cutting there is a system in vogue of estimating on moldings per lineal foot of each member of the face.

The Syenite Granite Co., of Graniteville, Mo., furnished about 36,000 cu. ft. of granite for the Merchants' Bridge at St. Louis. It was cut in courses from 24 to 30 ins. thick, and to ¼-in. joints, and was delivered in St. Louis at $1.15 per cu. ft. The actual cost for cutting beds and joints in work of this character, as estimated by this company, is about 20 cts. per sq. ft., independent of al contingent expenses, such as blacksmithing, handling, etc., which generally averages about 30% of the cutting.

The blocks of granite for Bunker Hill Monument, averaging 2 cu. yds. each, were quarried by wedging, and delivered at the site of the monument, at the net cost of $5.04 per cu. yd. The actual cost of getting out the rough blocks at the quarry was $2.70.

The rate of sawing is shown by the following table:

Material.	Locality.	Cutting agent used.	Depth cut in 10 hours.
Granite	Addison, Me.	Chilled shot.	10 ins.
"	Chester, Mass.	Sand.	*12 ins.
"	Red Beach, Me.	Chilled shot.	7.5 ins.
Bluestone	Hudson River	Sand.	*8 ins.
Marble	Carrara, Italy	"	*15 ins.
"	Tennessee	"	*9 ins.
"	Tate, Ga.	"	*6 ins.
"	"	"	*12 ins.
"	Gouverneur, N. Y	"	*12 ins.
"	W. Rutland, Vt	"	*20 ins.
"	Proctor, Vt.	"	*15 ins
Limestone	New Point, Ind.	"	10 ins.
"	" " "	"	15 ins.
Oolitic limestone	Bedford, Ind.	"	*40 ins.
" "	" "	"	70 ins.
Mag. limestone	Lemont, Ill.	"	*36 ins.
Sandstone.	N. Amherst, O	"	*40 ins.
"	Clarksville, O.	"	36 ins.
Brownstone.	Portland, Conn.	Chilled shot.	20 ins.
"	Hummelstown, Pa.	" "	25 ins.

* Automatic sand feeds.

Machine Work.—The introduction of machinery for sawing and cutting stone during the last 30 years, and its improvement during that time to its present perfection,

* Extracts from a paper by Mr. R. J. COOKE, Class of 1890, University of Illinois.

Berlin Street Maintenance in 1889.

Berlin street paving and cleaning is treated of in Reports of U. S. Consuls, No. 120, by W. A. EDWARDS, Consul General. The cost of removing snow daily from an average area of 3,390,491 yds., in the winter of 1888-89, was about $95,000. The average cost of snow removal in the 10 years, 1879-1889, was $63,143 per annum. In 1889 the street area requiring regular cleaning was 5,538,056 sq. yds.; the sidewalks covered 3,755,675 sq. yds. As good pavement is an essential factor in economic street cleaning, the area of this class of pavement was increased 195,000 sq. yds. in 1889, bringing the total to 1,785,600 sq. yds. The increase in wood pavement was only 2,736 sq. yds. for the year, with a total area of wood pavement in use of 91,114 sq. yds. In the year 103,708 sq. yds. of asphalt pavement were laid, making a total on April 1, 1889, of 681,486 sq. yds. of asphalt pavement.

The laborers engaged on street work receive from 60 to 72 cents per day. But they receive working clothes free; are promoted to the higher classes after 1½ years service; receive half pay in case of sickness and are paid for Sundays and holidays. After 10 to 15 years' service workmen receive a pension of $100 per year; and for 30 years and afterward, $150 per year, with relative allowance between. There were, however, only 11 pensioners in 1888-89. The population of Berlin in 1888 was 1,470,230, including a garrison of 20,595 men.

For street sweeping 42 machines were in use during the year, two for each district. The supply of horse and driver and the care of the machines are contracted out at $1.44 for each working day. Repairs on the machines are at the contractor's expense. The average cleaning capacity of each machine is about 7,680 sq. yds. per hour, and it is figured that this method of sweeping costs one-sixth as much as hand work. In 1888-89, 97,969 loads of street refuse and 175,256 loads of snow were removed, at a cost of 60 cents per load.

In general, all streets are regularly sprinkled twice a day, from April 1 to Oct. 1; and principal thoroughfares and squares are sprinkled three and four times per day in this period. For this work the contractor receives on an average $1.68 per day for each wagon. The 147 sprinklers used hold usually about 300 U. S. galls. Cleaning and sprinkling portions of streets occupied by railway companies is done by the city at the expense of the companies.

In the year 1888-89, the total expenses of the street cleaning department were:

Wages	$193,261.44
Uniforms	2,769.12
Tools, materials, etc	44,819.76
Carting away	182,487.12
Sprinkling	53,110.56
Depots for supplies	1,221.12
Public closets	1,279.44
Miscellaneous	2,544.48
Total	$481,493.04
Total receipts	26,586.48

In the city there are 124 public water closets with accommodations for 540 persons.

Alterations in the Washington Street Tunnel, Chicago.*

When the city of Chicago gave the West Chicago Cable Railway Co. the right to use the Washington St. tunnel one of the conditions imposed was that in putting it in repair the roof should be lowered 3 ft., thus giving a depth of water in the river of 17 ft. instead of 14 ft. below city datum. In order to do this the roof of the old tunnel had to be changed from that of an arched brick to a flat girder roof. The alterations in the structure have been carried on during the past winter under the directions of Fitz Simons & Connell, of Chicago.

The old tunnel under the Chicago River at Washington St. was constructed in the years 1867-68, but it had grown somewhat dilapidated, so that its use during the past two years has amounted to very little. The tunnel extends from Franklin St. on the south side to Clinton St. on the west side, a distance of 1,500 ft. Of this distance 370 ft. is open cut on each side of the river, the remaining 930 ft. being the tunnel proper. The grades to the entrance at the ends are 1 in 13 and 1 in 15.

The new roof was placed in position, not by completing the work within the tunnel itself, but by the building of cofferdams in the river so that the excavations and work could be entirely done from the outside. In order to do this and not interfere with navigation to any great extent one half of the river was cofferdamed at a time. These dams were built of two rows of 35-ft. piles placed 4 ft. apart on the outside row and 3 ft. apart on the inside row, making the dam 100 ft. long. The piles were sheeted up with heavy planks on both the inside and outside of the dam. Between these rows of sheeting the space was filled in with clay dredged from the bottom of the river close at hand, thus making a perfectly water-tight compartment. The space thus inclosed was 50 ft. across, and by a system of braces placed across the opening 14 ft. apart the dam was held in position until the work was completed. After the water was pumped from the dam, the work of tearing out the masonry in the old roof was begun. This was laid in Portland cement and required blasting. Nearly the whole of the masonry work in the old roof was found to be in good condition. The roof of the old tunnel was composed of a 10-in. course of limestone flagging on the outside; next to this was a 1-in. course of rock asphalt, and then 5-in. ring of brick arches.

The cross section of the old tunnel was a double arch resting on a center wall, leaving two 10-ft. openings for roadways. This section as far as the river has not been changed, but under the river the center wall was removed and placed over against the side wall, thus changing the opening to one 20 ft. wide. The roof of the new section is constructed of 20-in. steel I-beams, 24-ft. long, placed across the opening. These beams lie 26 ins. apart between centers. Between the beams and parallel to them are brick arches composed of three rings of brick, the arches having a rise of 8 ins. The two inner rows of brick in these arches were laid in Portland cement and the outer row in asphalt. The covering above the steel beams is a 10-in. layer of concrete laid in cement.

As the tunnel will not permit the passage of vehicles on account of the cable tracks the building of a drawbridge directly over the tunnel was necessitated. To accomplish this the abutments of the bridge were built in connection with and as part of the tunnel itself. The most interesting part about these abutments is the center pier upon which the drawbridge swings. This pier rests upon an arch with a span of 20 ft. and a rise of 6 ft. 6 ins., which is used as a substitute for the beams. This construction was not made in open cut, as was the remainder, but the old roof was not disturbed and the new arch at this pier was turned inside the old one.

Since the head room required for a cable car is 12 ft. 6 ins. and the roof was but 10 ft. above tracks after the beam roof was put in place, an excavation of 2 ft. 6 ins. was necessary in the floor of the tunnel, with an additional space below this for the cable conduit. The inverted arch in the old tunnel was constructed of hard sewer brick laid in Portland cement and could be taken out only by the aid of dynamite blasting; 2,500 cu. yds. of old brick were removed from the tunnel.

* A paper by Mr. F. J. Trenise, class of 1890, in Transactions of C. E. Club of University of Illinois.

THE BARABOO BRIDGE ACCIDENT, mentioned Nov. 29, is thus described by an official of the Chicago & Northwestern Ry., to whom we wrote for information. "The bridge over the Baraboo River, one span of which was wrecked on the night of Nov. 22, consisted of three spans of 75 ft. pony lattice girders on masonry. The central span was wrecked by a freight car which had been off the track for a considerable distance and which was thrown out of line and into the truss just as it reached the center span by the engine man's reversing his engine, he having just observed the sparks flying due to the truck skidding on the rails. The bridge floor was our standard type with ties 12 ft. × 6 ins. × 8 ins., spaced 14 in. centers, and with 10 in. × 12 in. guard rail bolted to every tie. The accident was in nowise due to the bridge or bridge floor." Another correspondent says: "The span which was wrecked was the middle of three 75 ft. iron lattice spans; the bridge was on a 3° curve."

BRIDGE AND TRESTLE ACCIDENTS are reported as follows: On Nov. 29 a derailed freight car caused the wreck of a small trestle on the Rome & Decatur R. R., near Farill's Station, Ala., and several cars were wrecked. A baggage car and sleeper went through a burning bridge near Cajon Pass, Cal., on the Atchison, Topeka & Santa Fé R. R., on Nov. 22. On Nov. 30 the derailed caboose of a construction train on the Allegheny & Kinzua R. R. fell over a trestle near Bradford, Pa. Four men were injured, and the car and trestle were burned. An open draw on the line between Digby and Annapolis, N. S., nearly caused an accident to a construction train Nov. 24, the bridge tender having signaled the track clear, but the train was stopped just in time. Safety appliances should be put in to guard against such carelessness. On Dec. 6 a break occurred in part of one of the steel trusses of the Grand Trunk Ry. suspension bridge over the Niagara River; until repairs were made trains were sent over the cantilever bridge.

THE PORT ROYAL DRY DOCK CONTEST has been reported upon by the board of civil engineers U. S. Navy, consisting of Messrs. ASSERSON, PRINDLE and MCCOLLOM. The bids were as follows, for a timber dry dock: J. MCCARTHY, Washington, D. C., $418,915; R. G. PACKARD, New York, $471,000; J. E. SIMPSON & Co., New York, $497,539; C. J. STALBRAND, Charleston, S. C., $326,620. The board recommends awarding the contract to Mr. PACKARD, with certain changes in his plans. Messrs. SIMPSON claim that the three other bids are informal. The chief of the Bureau of Yards and Docks, Com. FARQUHAR, says that if SIMPSON'S objections are sustained he will award the contract to him. If the bid cannot be accepted, the board recommends the rejecting of all bids and a readvertisement for proposals.

A NEW NIAGARA RIVER BRIDGE seems to be in contemplation. A Lockport item says that Mr. IRWIN, of Montreal, and an engineer corps are at work and that property has already been secured on each side of the river, near the Falls. Rumor has it that the Canadian Pacific Railway is interested.

NIAGARA FALLS, on the Horseshoe side, has receded 140 ft. 6 ins. since 1842, says State Engineer BOGART to the State Reservation Commission. This is an average of over 2 ft. per year, with a maximum recession at any one point of 270 ft. The main recession of the American Falls, in the same period, was 36 ft. 6 ins. The total area of recession, since 1842, was 32,900 sq. ft. on the American side, and 275,400 sq. ft. at the Horseshoe Falls. Mr. BOGART reported that as the estimated volume of water passing over the Falls was 270,000 cu. ft. per second, the 10,000 cu. ft. per second to be utilized by the power tunnel now building would have no appreciable effect on the Falls.

THE FORTY-SECOND ST. TUNNEL FRANCHISE was granted by the New York Aldermen on Dec. 9. The New York & Long Island R. R. Co. has a Legislative charter to construct a tunnel commencing at the Hudson river and running directly across New York and under the East river to Long Island City. According to the plans the tunnel would be excavated in solid rock, with the road bed about 100 ft. below the street surface. The width of the section would be 27 ft. and height 22½ ft. Electric locomotives are proposed. The grade toward the East river would be 68 ft. to the mile, and the tunnel would pass 50 ft. below the river bed, and, rising again, reach the surface about one mile east of the river. The estimated cost is put at about $1,000,000 per mile, exclusive of stations. The latter would be located in Forty-second St. at Sixth, Ninth, Third and Second Aves., and elevators would connect the tunnel and streets. Mr. J. D. LEARY is now at the head of the reorganized company.

THE ST. LOUIS WATER POWER on the St. Louis River above Duluth, Minn., was transferred, on Nov. 26, to a syndicate of Duluth, Eastern and English capitalists for $1,000,000. Another million is to be expended on dams, etc. The useful fall is 300 ft. and the minimum flow is 1,200 cu. ft. per second. The new company expect to erect vast mills and to transmit power to other points by electricity. Mr. JAY COOKE, of Philadelphia, was one of the former owners.

THE IRRIGATION LAWS OF COLORADO, already among the best in the country, have been examined with a view to their amendment by a State Water Commission, consisting of J. S. Greene, T. C. Henry and E. T. Wells. The report of the commission consists of a recommendation for a thorough revision of the present laws in order to prevent abuses, and extend and strengthen parts of the law which in practice have proved inadequate or weak. The different uses of water are more clearly defined in the proposed law and provision is made for the adjudication of priority of right for fair rates, equable distribution of water, economy in use and also for experiments in the rotation of water. The recommendations are given in full in the Denver *Republican* for Dec. 2.

AN ARTESIAN WELL is proposed for the water supply of Jerusalem, and an enterprising Greek has been backed to the extent of $10,000 by a local bank for the purpose of sinking it. The *Pall Mall Gazette*, however, says that that as Jerusalem is surrounded by limestone mountains the contractor may have his "hole" for his pains.

A NEW ELECTRIC WELDING MACHINE has been brought out by the Thomson Electric Welding Co., of Boston, Mass., which they have been perfecting for several months. It is adapted to miscellaneous work, and expected to prove of special advantage to metal workers who have a large variety of work, and whose annual product will not warrant their purchasing the larger welding plants which the Welding Company have been furnishing. The new plants are being built of three distinct types, in all covering a range of from 5 sq. ins. to ⅛ sq. in. section. They are furnished with a variety of interchangeable clamps. The welders can be run by any competent employee, and the simplicity of their construction and adaptibility to a great variety of welding is expected to lead to much wider use of electric welding by machinists and others who do more or less welding, and desire such a machine constantly at hand ready for use. The company installs the plants, adapting the clamps to such work as may be presented and instructs those who may be placed permanently in charge of the machines, after which there is said to be little likelihood of trouble from inexperience. The welders do not require special attention, and render unnecessary the use of the forge for any kind of ordinary shop welding.

THE AM. SOC. C. E. NOMINATIONS on the eight separate tickets sent in have been issued by the Board of Direction, as given in these columns last week, but adding the names of the proposers. On nearly every ticket one or more declinations are noted, and in addition to those noted, Mr. HOWARD WHITE has declined a nomination for treasurer and Mr. ALFRED P. BOLLER a nomination for director, while accepting that for treasurer. The other declinations are as follows: Mr. J. BOGART declines nomination as vice-president and renomination as secretary, and accepts nomination as treasurer. Mr. C. B. BRUSH declines as vice-president and treasurer, and accepts as director. Mr. FRANCIS COLLINGWOOD declines as treasurer, and accepts nomination for secretary. Messrs. GREENE, COOPER, MYERS, KATTE, NICHOLS, and MYERS decline one or more nominations each, and do not run. The opposing nominations have now simmered down to those for one vice-president, secretary, treasurer, and one director, with Messrs. KATTE, TRAUTWINE, BOLLER, and CHILDS on the one hand, and Messrs. FTELEY, COLLINGWOOD, BOGART, and BRUSH on the other.

THE ELECTRIC WIRE REGULATIONS in London England, recognize three kinds of supply: (1) Low pressure at or below 300 volts for continuous currents and the equivalent of 150 volts for the alternating currents (2) high pressure, not exceeding the equivalent of 3,000 volts either alternating or continuous; (3) extra high pressure, exceeding 3,000 volts. The low pressure only is in general use, but on the joint application of the consumer and the contractor the Board of Trade may permit of a high pressure for special purposes. The extra high pressure supply can only be used on premises belonging solely to the contractors and then only with the written consent of the Board of Trade. Aerial conductors are to be kept at least 20 ft. from the ground; at street crossings the height must be 35 ft., and no part of a building of any kind is to be within 7 ft. of the wires except where house connections are made.

THE METRIC SYSTEM has been declared by Secretary WINDOM impracticable of adoption in our custom houses under the laws now in force. Mr. WINDOM, however, declares that he believes that under proper laws the metric system would facilitate commerce between ourselves and other American republics, and also the transaction of the business of the custom houses.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

West Shore.—Engineers are now at work on a branch from Saugerties, N. Y., to the Hotel Kaaterskill in the Catskills, and it is announced that the line will be built.

Cleveland Belt.—The rails have been ordered and tracklaying will soon begin on this 7-mile line at Cleveland, Ohio.

Old Colony.—This company has purchased a large tract of land at Brockton, Mass., and will construct large freight and passenger stations.

Woonsocket & Pascoag.—Tracklaying is now progressing at the rate of ½ mile per day, and it is expected to have the line completed to Slatersville, R. I., soon.

Philadelphia & Reading.—It has been decided by the Law Committee of the City Councils in Philadelphia to report favorably on the bill introduced last week granting this company the right to construct an elevated railway through certain portions of the city, in order to extend its tracks to connect with the company's projected terminal station at Twelfth and Market streets.

Lehigh Valley.—The line from Newark to Roselle, N. J., 6¾ miles, has been completed.

Pennsylvania.—The Harrisburg & Bedford R. R. Co. has been chartered in the interest of this road to build a railway from a point near Shippensburg, Pa., to a point near Mt. Dallas, Pa., about 60 miles.

Louisville, New Albany & Chicago.—M. A. Zook, of Indianapolis, Ind., informs us that this company will make many improvements during the coming year. The work will comprise the construction of a large number of iron bridges, laying new rails, and repairing depots and stations.

Projects and Surveys.

Reading & Southwestern.—Chartered in Pennsylvania to build a railway from Reading to Mohrsville, Pa., 5 miles.

Oil Valley.—Chartered in Pennsylvania to build a railway from Watsontown, Pa., to Wilber Station, Pa. Chas. A. Ward, Binghamton, N. Y.

Winnipeg & Hudson Bay.—The Canadian Parliament will be asked at the approaching session to incorporate a company with power to operate a railway from Winnipeg to the Saskatchewan River and Hudson's Bay, and with power to construct and navigate steam vessels on Hudson's Bay. The proposed road will be a link in a projected grain-carrying route to England.

Rumford Falls & Portland.—The Maine State R. R. Commissioners have approved the articles of association of this company noted last week.

Hiram.—Surveys and estimates have been made for a railway 3½ miles long, from Hiram, O., to a connection with the New York, Lake Erie & Western R. R. F. L. Kause, of Cleveland, O., is Chief Engineer.

Valleyfield & Malone.—It is announced that the necessary arrangements have been completed for building the proposed railway from Valleyfield to Malone, N. Y.

Northern Maine.—At the annual meeting of the stockholders recently held, the following directors were elected: George P. Wescott, Geo. H. Freeman, J. W. Bolton, L. Powers, H. C. Sharp, J. H. Manley and A. F. Crockett. The road is projected to run from Presque Isle to Mattawamkeag, Me., 116 miles.

SOUTHERN.—Existing Roads.

Tavares & Gulf.—W. B. Tucker, of Orlando, Fla., writes us as follows:

About 100 men are now at work on the line from Waits' Junction to Black Lake, Fla., 7½ miles. The grading is all completed, and tracklaying is in progress. The principal business will be in fruits and other agricultural produce. Charles S. Noble, of Tavaris, Fla., is engineer in charge of work. The road will be opened for traffic about Dec. 20.

Fort Payne & Eastern.—W. F. Carley, Chief Engineer, has a corps of surveyors in the field staking out the right of way for the extension of that line from its present terminus at Coal Mine, on Lookout Mountain, to Augusta, Ga. Coal Mine is about 10 miles south of Chattanooga, on the mountain top. The surveyors are divided into three divisions. The first division is on the route from Coal Mine to Summerville, via Menloe; the second division from Summerville to Gainesville, and the third from Gainesville to Augusta. Three surveys are being made, and work will begin as soon as the right of way is decided on. A survey of the western branch of the same line from Fort Payne to Stevenson, on the Nashville & Chattanooga R. R., has been completed, and work will commence at an early date.

Atlantic & Danville.—At a recent meeting of the directors it was decided to build at once the Danville & East Tennessee R. R., from Danville, Va., to Bristol, Tenn., about 200 miles.

Projects and Surveys.

Atlantic & Alabama.—L. E. O'Keefe, of Atlanta, Ga., Secretary and Treasurer, writes as follows:

The surveys have been made and the right of way has been secured for this railway, which is projected to run from Atlanta, Ga., to Selma, Ala., a distance of 150 miles. The route is through a good cotton and timber country, and the work will be generally light. There will be two bridges on the line. The principal business will be in timber, cotton, ores, and a general freight and passenger traffic. No effort has been made to secure local aid, but it is thought that there will be no difficulty in obtaining large bonuses from the people along the route. H. B. Tomkins is President.

Alexandria Ry. & Improvement Co.—The charter for this company, with authority to build a railway from Arlington to Mt. Vernon, Va., which was granted last session by the Virginia Legislature, has been formally accepted by the company. The following officers have been elected: President, Hon. A. C. Harner, of Philadelphia; Vice-President, Cazenove G. Lee, of Virginia; Treasurer Beriah Wilkins, and Secretary, J. S. Lawrence, of Washington. The officers and Mr. D. C. Forney constitute the board of directors.

Southern Iron & Timber Co.—This company proposes to build a railway from English Mt., via Newport, Tenn., and up the Pigeon River to the North Carolina State line.

Mobile & Northwestern.—Chartered to build a line of railway in Alabama. The Mobile Construction Co. has been chartered in connection with the railway company. The incorporators of the construction company are John H. Turner, J. G. Ruffin, Jr., of Mobile; H. Merigold, of Lima, O.; Archie McDonald, of St. Paul, Minn.; D. H. Campbell, of Anniston, Ala. The object of the construction company is stated to be the construction of railroads, water-works and sewers. The incorporators of the railroad company comprise the above named and Nesbit Turnbull, of Baltimore, and Elmo Christman, of Minneapolis.

Chicago, Henderson & Chattanooga.—Surveys will soon commence for this railway in Kentucky.

NORTHWEST.—Existing Roads.

Winona & Southwestern.—Work will soon be stopped on this road for the winter. It is now in operation from Winona, Minn., to Spring Valley, 75 miles, and considerable grading has been done between the latter point and Osage, Ia. Surveyors are now locating the line between Osage and Mason City, Ia., where connection is made with the Mason City & Ft. Dodge R. R., recently purchased by the company. It is probable that the extension from Fort Dodge to Omaha, Neb., will not be built for some time.

Port Edwards, Centralia & Northern.—The grading is nearly completed between Port Edwards and Marshfield, Wis., 22 miles, and track has been laid from Centralia to Vesper, Wis.

Projects and Surveys.

Dakota, Wyoming & Missouri River.—Wm. T. Coad, of Rapid City, S. Dak., President, writes as follows:

This road is projected to run from Rapid City, S. Dak., to Hill City, S. Dak., and thence to the Wyoming coal fields, a distance of 250 miles. Surveys will be completed about February, 1891, and it is expected to let contracts about March, 1891. The route is through a good mineral section, and the road will be easy to construct. The principal business will be in tin, iron, coal, and other minerals, and the general freight and passenger traffic. Considerable local aid is expected from Rapid City and other towns along the route. Other capital for construction will be obtained by sale of bonds. Chas. J. Howell is Chief Engineer.

Chicago, Danville & Ohio River.—Chartered in Illinois to build a railway from Chicago to Paducah, Ky. Among the incorporators are: Richard A. Allen, Chas. W. Carr, and John A. Stack.

Rock Island, Peoria & St. Louis.—Chartered in Illinois to build a railway from Peoria to East St. Louis, Ill. Among the incorporators are: A. F. McFarland, H. E. Wilson, and C. E. Tate, all of Charleston, Ill.

British North American.—Application will be made to the Canadian Parliament next session for an act to incorporate the British North American Ry. Co. with power to construct and operate a railway from Winnipeg to the Saskatchewan River, and to extend its line to Hudson's Bay, and with power to construct, charter and navigate steam and other vessels, and to construct and operate all necessary works in connection therewith, and also with power to acquire the line of the Winnipeg & Hudson's Bay Ry. Co.

SOUTHWEST. Existing Roads.

Aransas Pass & Harbor Island.—Steel rails and other construction material is rapidly arriving and the grading and pile driving is making rapid progress.

Waco, Lampasas & Llano.—The grading has been commenced on this Texas railway. It is expected to have the section from Lampasas to Llano completed by Oct. 1 1891.

Corpus Christi & South American.—The officers of this company are now in the East purchasing construction material and rolling stock for the road.

Projects and Surveys.

Omaha, Kansas Central & Galveston.—At a meeting of the stockholders of this recently incorporated company the following officers were elected: President, Jacob Newburger of New York city; Vice President, C. M. Rawlings of Alliance, Kan.; Treasurer, D. M. Bell of Alliance; Secretary, Valdemar Sillo of New York; Chief Engineer Edward Roemer of New York. The offices of the president and secretary are to be in New York, while the headquarters of the other departments will be in Alliance, Kan. The line will extend from Omaha to Galveston. It is reported that the money necessary to carry the enterprise through has all been pledged.

Beeville, Lagarta & Rio Grande.—An effort is being made by the people of Lagarta, Live Oak Co., Tex., to secure the construction of a railway from that place to Beeville, Tex. H. B. Newberry, of Lagarta is interested.

New Iberia, Vermillion & Western.—The citizens of New Iberia, La., have voted a tax of five mills for ten years in aid of this enterprise. The road is projected to run from New Iberia to Vermillion, La. R. S. Perry of New Iberia, is interested.

ROCKY MT. AND PACIFIC.—Existing Roads.

Northern Pacific.—H. S. Huson, Assistant Engineer, is reported as saying:

"We are going ahead with all our construction work, except on the Raging River line. There we gave the contractors permission to suspend work for the winter on account of bad weather, because it is very difficult work. Work will be resumed about April. On the Gray's harbor line we are laying track from both Olympia and Elma, and expect to have it completed about Jan. 1. Work is going along well on the Belt line, and we are laying track from the Y to Renton. It will be interrupted for the construction of a truss bridge over the Cedar River. We expect to make an amicable settlement of the difficulty with the Oregon Improvement Co. about the crossing at Renton. We are about to connect the track of the Northern Pacific & Montana road at Cœur d'Alene. This road will run from Cœur d'Alene to Missoula, and the 100 miles just completed will give us an all-rail route to the mines. At present we cross the lake by steamer. We propose to build down along the lake, and may also complete the line through to Missoula, thus making a considerable cut-off, and penetrating into that whole mining district."

Great Northern.—It is expected that the Fairhaven & Southern R. R. will be completed to New Westminster, B. C., about Jan. 15. After the track is laid there will be considerable ballasting to do, as much of the road runs through low, marshy ground, and this will delay the completion of the road until the date named. The rails will then be brought in over this road and tracklaying begin on the Seattle & Montana R. R.

Projects and Surveys.

Stanley, Cascade & Eastern.—Chartered in Washington to build a railway from Stanley to North Yakima, Wash. Surveys will commence at once. The principal offices will be at Chehalis, Wash.

Salt Lake, Hailey & Puget Sound.—Chartered in Utah to build a railway from Salt Lake City, Utah, to Hailey, Idaho.

Newport & Arlie.—A project is on foot to build a railway from Newport to Arlie, Ore.

FOREIGN.

Demerara.—The Demerara Ry. Co., of London, England, is considering the question of tendering for the construction of the extension of the railway to Berbice, and of a new line on the west coast, as required by the Colonial Government. Additional capital will have to be raised.

Peru.—The Pacasmayo & Guadalupe Ry. Co. has been organized in London, England, with a capital stock of $1,000,000, to acquire the rights of the Peruvian Corporation and its concessions, and to carry into effect an agreement made Nov. 13, between the Peruvian Corporation, Thos. E. Webb (of the company), and Michael P. Grace.

Uruguay, So. Am.—The Uruguay Northern Ry. Co. has completed and opened its first section, and it is expected that the remainder of the line will be opened for traffic by next May. The line will extend to the border of Brazil and will have connections with the Midland, Northwestern and Central railways of Uruguay.

Spain.—A press despatch from Brussels says:

La Nation announces the impending formation in Madrid of a new railroad company which will connect all Spanish lines. The new concern is to be known as the Grand Central Ry. Co., and is to be capitalized at £3,000,000. The Royal Portuguese Ry. Co. and Belgian, Spanish, French and Portuguese financiers are interested in the project. Señor Sagata will be offered the presidency of the new company.

CITY TRANSIT.

Electric Railways.—New lines or extensions are proposed at Salem, Mass.; La Porte, Ind.; Chicago, Ill., address D. V. Purington; Calumet, Ill.; Clinton City, Ia., address Baldwin Electric Car Co., Aurora, Ill.

Springfield, Mass.—The Springfield Street Ry. has received permission to use the overhead electric system on all its lines save one.

Northbridge, Mass.—Articles of incorporation have been granted to the Whitinsville Street Railway Co. to conduct an electric street railway from this town to Whitinsville station, a distance of 1¼ miles.

West Haven, Conn.—The West Haven Horse R. R. has bought land for an electric power plant, and applied for permission to use the overhead system.

Randolph, N. Y.—About $8,000 has been subscribed by residents of this village and East Randolph for an electric railway between the two places. The line will be 2½ miles long, and probably cost about $20,000.

West Orange, N. J.—The Township Committee has given the Newark Passenger R. R. right to lay tracks on a number of streets, and to operate the cars by the overhead system.

Brushton, Pa.—The Duquesne Traction Co. has been granted right of way on several streets of the borough. The company is to pave between, and 1 ft. on each side of, the tracks.

Roanoke, Va.—The Black conduit system was tested recently in this city, and is reported to have given excellent results. A trolley contact is used instead of the more usual brush connection usually employed in underground work.

Cincinnati, O.—The Consolidated Street Ry. will equip part of its track with the Thomson-Houston system as soon as possible, the intention being to gradually introduce electricity on all the lines.

Indianapolis, Ind.—The United States Electric Car Co., of Chicago, is reported to have ordered track material and electric machinery for a storage battery line between this city and Broad Ripple.

New Albany, Ind.—A local newspaper reports that there is some talk of operating the New Albany Highland Ry. by electricity instead of steam, as was at first intended. The road will not be opened until spring, considerable trestling and grading still remaining to be finished.

Dubuque, Ia.—It is probable that the new system of electrical car heating will be tried on the electric railway.

Denver, Colo.—The Denver & Berkeley Park Rapid Transit Co. has petitioned for a change in its franchise, so that it may use electricity on its lines. The Highlands Street Ry. has also applied for a change in its franchise, by which it may operate by steam motors for 12 months and afterward use electricity.

San Diego, Cal.—W. W. Manspeaker and B. Roberts, of Topeka, Kan., and J. M. Davis, of Los Angeles, have applied for an electric railway franchise. They are willing to spend $200,000 on the road, but also want a subsidy from the residents.

Oakland, Cal.—A. L. and E. B. Stone, W. J. Landers and C. E. Palmer have petitioned for an electric railway franchise on a number of streets.

Elevated Railways.—*Chicago, Ill.*—A Boston press dispatch states that a company of Boston capitalists have secured a franchise for the railway connecting the exposition grounds at Jackson Park and Lake Front, and will put up a 10-mile elevated structure on the Riley system.

New Companies.—Whitinsville, Mass., St. Ry.; capital stock, $20,000; W. E. Johnson, Secretary. Vancouver, Wash., St. Ry.; capital stock, $20,000. Olympia, Tumwater & Brighton Park Motor Co., Olymia, Wash.; capital stock, $30,000. Chicago, Blue Island & Harvey St. Ry., Chicago, Ill.; capital stock, $250,000; incorporators, J. McCalmont, E. H. Rexford, A. Reiner.

HIGHWAYS.

New Jersey.—The New Jersey law which was passed 2 years ago permitting the various counties of that State to issue bonds for the improvement of country roads has led to movements in that direction in other States. There is no county in New Jersey, says the New York *Times*, in which the law has been given a fairer trial than in Union County. Bonds have been issued in that county to the amount of $300,000, and the money obtained by this issue will be sufficient to put in fine condition some 30 miles of country roads, extending from Elizabeth to Plainfield and from Rahway to Summit. The original estimate of expense for these improvements was $10,000 per mile, and this sum has proved sufficient for them. The roads are now nearly finished, and for the first time in the history of Union County, they are in condition for all sorts of travel in every season of the year. It is alleged that in bad weather one horse can now draw a load which required the strength of 4 horses before improvements were made.

New York.—At a meeting of the Niagara Co. Farmers' Club, at Lockport, N. Y., on Dec. 2, the State road scheme of Gov. Hill, and any legislation in that direction were strongly opposed as unnecessary and involving too much expense and taxation. The club seemed to be in favor of controlling the roads. A committee was appointed to report upon what legislation is needed for roads, and to confer with other clubs.

Pennsylvania.—The farmers of Harmer are reported to have settled the country road question by allowing the superintendent of the county jail to rebuild the highways with convict labor. The cost for macadamizing is said to have been about 69 cts. per ft., and the results have been very satisfactory.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Chester, Vt.*—The railway bridge recently destroyed by fire will be replaced at once. The span is about 120 ft.

Staten Island, N. Y.—A bridge is to be built over the Fresh Kill between Northfield and Westfield. There will be a pile trestle approach, and a drawbridge with iron or wood center pier, having clear openings of 30 ft. The total length of trestle and bridge will be 2,500 ft. Plans and specifications have been prepared by Mr. Wm. S. Bacot, engineer of county roads, Stapleton, S. I., and the work will be done under the supervision of the Board of County Supervisors.

Pittsburg, Pa.—A charter has been issued to the Upper Bridge Co., Pittsburg, to construct a bridge over the Monongahela, in the Twenty-third ward, with $200,000 as capital, and as directors James D. Callery, John C. Reilly, Wm. J. Burns, Charles G. Minor and Wm. M. Callery, of Pittsburg.

Atlanta, Ga.—Plans are being prepared by the City Engineer for a bridge over the railway at Broad street. R. M. Clayton, City Engineer.

WATER-WORKS.

NEW ENGLAND.

Rockville, Conn.—Dec. 5 the city voted to petition the Legislature for permission to issue $150,000 of bonds for water-works. Works were built here by the Rockville Aqueduct Co. in 1847, and it is reported that this company will petition for an increase of its capital stock to $125,000, and will contest the city's right to the ownership of works.

Unionville, Conn.—M. J. Weeks informs us that a petition for the incorporation of a water company will be presented to the General Assembly in January.

MIDDLE.

Amsterdam, N. Y.—An additional supply of 5,000,000 galls. daily has been made possible by the completion of the Hans Creek conduit, about 14 miles long, and the construction of a dam, all at a cost of about $130,000.

Crisfield, Md.—It is reported that a water company has been formed.

SOUTHERN.

Bridgeport, Ala.—The Bridgeport Water-Works Co. (new) wishes catalogues from manufacturers of meters; also rules and regulations of water companies using meters.

Water Valley, Miss.—The following is from A. F. Benson, Batesville, Ark:

The Arkansas Water-Works & R. R. Co. expect to begin the construction of works Feb. 1. Water will be pumped from driven wells directly to the mains. Estimated cost, $30,000. The company's bonds have not been floated. A. F. Benson is Engineer. The work will be done by the company. Population, 4,680.

NORTH CENTRAL.

Delphi, Ind.—Works are being discussed. Address the City Clerk.

Logansport, Ind.—The following is from City Engineer W. A. Osmer:

A new 1,500,000-gall. pumping engine is to be put in next year. Until recently the supply has been taken from the Eel River. Tubular wells have recently been put down by A. W. Stevens, and water is now to be pumped from these wells directly to mains.

Chicago, Ill.—It is reported that plans are being made for a new shore inlet crib, at the north of and close to the government breakwater, in 30 ft. of water. This crib would be connected by a 7-ft. tunnel with the present tunnels at Chicago Avenue; and would give an increased supply at an early date. The estimated cost of the whole works is $100,000.

Antigo, Wis.—A. W. Stevens, contractor, Logansport, Ind., informs us that the new works at this place are practically completed.

Ripon, Wis.—The new water-works were completed about Sept. 1. A. W. Stevens, Logansport, Ind., was the contractor. See the MANUAL OF AMERICAN WATER-WORKS for 1889-90 for futher particulars.

NORTHWESTERN.

Hamburg, Ia.—J. S. Kennedy, Superintendent, informs us that works with two miles of mains and 12 hydrants are being built.

Leeds, Ia.—This village has recently been annexed to Sioux City, and plans for a supply are being considered by the city authorities.

Orange City, Ia.—A. J. Kuypner, Recorder, informs us that the bonds voted Dec. 2 will amount to about $6,500 and will be used for a fire protection plant. An engineer will be employed to develop a supply and plans and specifications will be advertised for. Work will not be started until April or May. Population, 1,300.

SOUTHWESTERN.

Columbia, Mo.—Byron Nowell is Secretary of the board having charge of the new works for which bonds have been voted.

Dublin, Tex.—J. E. Stancil informs us that he has a franchise for works here and is now sinking an artesian well for a supply.

Fairland, Tex. (Dallas P. O.)—The Fairland Water-Works & Park Co. propose to put in works.

McGregor, Tex.—It is reported that a water company has been organized.

Yoakum, Tex.—The following is from M. P. Kelley President:

The Yoakum Water & Power Co. began the construction of works in September, with B. R. Copeland as Engineer and Contractor. There will be 6 miles of mains, a 1,000,000-gal[l]. Worthington pump and a 16 × 110-ft. standpipe. Cost, about $60,000. Population, 2,600.

PACIFIC.

Cheney, Wash.—The Cheney Water Co. has just completed works.

Hoquiam, Wash.—Works to cost $100,000 are projected by an outside company.

Mullan, Idaho.—A small plant was put in operation here Oct. 15. It is owned by A. M. Strode.

Wallace, Idaho.—Works are being built.

CANADA.

Brandon, Man.—John C. Kerr, City Clerk, informs us that works may be built before next season. The supply will probably be from wells.

Calgary, N. W. T.—Wm. Kennedy, Jr., Owen Sound, Ont., informs us that the Calgary Gas & Water Co. will have their works in operation about Dec. 15. There are about five miles of mains. Direct pumping is used. Mr. Kennedy is Engineer and H. B. Alexander is Secretary of the company.

ARTESIAN WELLS.

Americus, Ga.—Proposals for sinking a well are wanted by J. B. Felder.

Harriman, Tenn.—Wells may be sunk by T. E. Cross, New York City.

IRRIGATION.

Nebraska.—The Tarryall Irrigating, Canal and Water Supply Co. has been incorporated with an authorized capital stock of $20,000. The canal will extend from the North Platte River, near the Wyoming line, through Scott's Bluff and Cheyenne Cos. It will be 6 ft. deep and 150 ft. wide.

San Mateo, N. M.—The San Mateo Irrigation Co. proposes to construct a reservoir and ditches. The company has a capital stock of $10,000; Ireno L. Chavez and Pablo Pena are interested.

Lemoore, Cal.—The Lake Ditch Water Co. has been incorporated with a capital stock of $5,000. Justin Esrey and E. Hill are among the directors.

Red Bluff, Cal.—The Thames Creek Irrigation & Improvement Co. propose to construct irrigation works in Thehama Co. The capital stock of the company is $100,000, all of which has been subscribed. C. B. Ashurst and A. J. Hammons are the principal stockholders.

Whittier, Cal.—A. L. Reed, Secretary, informs us the East Whittier Land & Water Co. are at work on 10 to 12 miles of conduit and flume, and are developing water from artesian wells to supply their ranch and to sell for irrigating and other purposes. The conduit will extend through Whittier and the company may supply the village with water.

SEWERAGE AND MUNICIPAL.

Sewers.—*Houlton, Me.*—The Houlton Sewerage Co. proposes to extend its line of pipe about 2,000 ft. next year. The company does its own work and charges yearly rates.

Holyoke, Mass.—The cause of the caving in of a part of the Front St. sewer is said to be that a proper foundation was not secured across marshy ground, and the cost of repairs is estimated at $15,000.

Rochester, N. Y.—The special committee on the east side trunk sewer has engaged Mr. S. L. Gray, of Providence, R. I., to report on the proposed improvement.

Roanoke, Va.—An ordinance has been passed appropriating $50,000 for sewerage purposes. The city engineer, Mr. Dunlap, thinks that the creeks through the city should be utilized as outfall sewers, with concrete bottoms, stone walls, and brick arch roofs. Plans for a sewerage system will be prepared by Mr. Rudolph Hering.

Wilmington, N. C.—Plans for a sewerage system will probably be prepared by Mr. Rudolph Hering. The matter will be decided at the January meeting of the Board of Aldermen.

Logansport, Ind.—Mr. Osmer, City Engineer, informs us that a complete system of sewerage will be put in next year. Investigations were made by Mr. Hering some months ago, and his report is now awaited. The preliminary surveys were made by Mr. Osmer.

Peoria, Ill.—A 34-in. brick sewer, with 8 in. walls, is to be built in Main St., the laterals will be of 12 and 18-in pipe; there will be manholes and 2 flush tanks. The city will pay 25% of the cost.

Kansas City, Mo.—Mr. Butts, the City Engineer, has submitted to the Board of Public Works a scheme for dividing the city into six large sewer districts and providing for the construction of sewers, so as to eventually form a complete system.

Mobile, Ala.—The general council has adopted the report of the committee making sewerage and paving obligatory on the citizens, and proposes to submit to the Legislature a bill embodying this idea.

Llano, Tex.—Plans for a sewerage system are said to have been prepared by M. L. Lynch, of Fort Worth.

Streets.—*Manchester, N. H.*—The construction of tar-concrete paving is suggested, on a system proposed by C. H. Robie.

Boston, Mass.—The Street Department has stated that an additional sum of $200,000 is needed at once.

Newark, N. J.—A pavement of vitrified brick on a 4-in. bed of concrete has been laid on William St. The joints are filled with sand and gravel, and grouted with tar.

Cincinnati, O.—Asphalt paving is proposed on Tusculum ave.

Hartford City, Ind.—The Talbot Paving Co., of Detroit, Mich, has recently laid 1½ miles of cedar block pavement. Mr. W. A. Osmer, of Logansport, was the engineer.

Logansport, Ind.—When the new sewerage system is decided upon plans and estimates will probably be made providing for a considerable amount of paving. For particulars address W. Osmer city engineer.

Raleigh, N. C.—Application will be made at the coming session of the Legislature for an amendment to the city charter, to enable the city to contract a debt for paving purposes. For particulars address the Mayor.

Cicero, Ill.—Ordinances have been passed providing for cedar block paving on Oak Park Ave., and the macadamizing of Clyde and Austin Aves.

Gas.—*Council Bluffs, Ia.*—The Iowa Fuel & Power Co. will put in a plant with a daily capacity of 6,000,000 ft. of gas, and will lay pipe as rapidly as possible. The architects of the buildings are Messrs. Bell & Berninghoff.

ELECTRICAL.

Electric Light.—New plants or extensions of existing stations are proposed at Swanton, Vt.; Bement, Ill.; Gardiner, Me., address H. W. Jewett & Co.; Titusville, Fla., address the Electric Light Co.; Henderson, Ky., address the Mayor; Ashville, Ala.; Anniston, Ala.; Columbia, Mo.

Manchester, N. H.—An incandescent light plant will soon be installed here. Water power will be obtained by a 12-ft. dam and developed by Rodney-Hunt turbines. Power will also be supplied electrically to consumers if desired.

Worcester, Mass.—The State Board of Gas and Electric Light has forbidden the prorosed consolidation of the gas and electric lighting interests in this city on the ground of its tending to create a monopoly.

New York City.—The following bids for electric street lighting were recently opened: Brush Electric Illuminating Co., 299 lights at 43 and 45 cts.; United States Illuminating Co., 309 lights at 43 cts.; East River Electric Lighting Co., 247 lights at 44½ cts.; Mount Morris Electric Lighting Co., 171 lights at 43 cts.; Harlem Lighting Co., 211 lights at 43 and 50 cts.; North New York Lighting Co., 28 lights at 50 cts. All the bids are from 2 to 3 cts. higher than last year.

Buffalo, N. Y.—The Brush Electric Light Co. has placed nearly 10 miles of its lines underground. The conduit is a sheet iron pipe coated inside with an inch of Portland cement. Paraffine blocks are placed in these pipes as supports for the wires. Brick manholes, 4 ft. square and 4 to 6 ft. deep, are built at intervals not exceeding 300 ft.

Northport, Ala.—The City Council has applied to the legislature for permission to issue bonds for an electric light plant.

Sprague, Wash.—The city has voted $35,000 of bonds for purchasing an electric light plant and water-works.

New Companies.—Morgan Park Electric Co., capital stock, $25,000; incorporators, F. S. Wheaton, G. A. Meech, J. H. Westovers. Electric Machine Co., Chicago, Ill., capital stock, $5,000; incorporators, E. S. Tomlinson, H. A. Caldwell, J. F. Flannery. New Electric Storage & Power Co., Chicago, Ill.; capital stock, $250,000; incorporators, J. E. Wiles, J. A. Sharp, J. B. Hogue. Crisfield, Md., Electric Light Co.; capital stock, $10,000; incorporators, G. F. Atkinson, F. H. Coulbourn, L. E. P. Dennis. Vermont Electric Co., Burlington, Vt.; capital stock, $100,000; E. J. Garfield, W. S. Vincent, W. H. Lang, directors. Wheaton, Ill., Electric Light & Water Co.; capital stock, $20,000; incorporators, H. H. Fuller, J. J. Cole, C. W. Kimball.

CONTRACTING.

Dredging.—*Baltimore, Md.*—Proposals for dredging in the channel leading to the harbor were opened Dec. 2 by Col. Wm. P. Craighill, U. S. Engineer Office, Baltimore. The bids for parts A, B, C and D ranged from 11 to 13.9 cts., 9 to 11 cts., 13½ to 21 cts., and 7 to 10½ cts. per cu. yd., respectively. The bids for the whole work were as follows: Baltimore Dredging Co., 13¾ cts. per cu. yd., $821,250; Atlas Dredging Co., Wilmington, Del., 12½ cts. $810,000; Moore & Wright, Portland, Me., 13½ cts., $817,500; Geo. C. Fobes & Co., Baltimore, 13.9 cts., $834,000; P. Sanford Ross, Jersey City, N. J., 13¾ cts., $824,750; Kaufman Simon, New York, 10.85 cts., $651,000; American Dredging Co., Philadelphia, 10½ cts., $630,000; Morris & Cumings Co., New York, 13.45 cts., $807,000. The National Dredging Co., of Wilmington, Del., bid on sections only.

Levees.—*New Orleans, La.*—The Board of Commissioners, Orleans Levee District, have awarded the contract for Pelican Brewery levee to R. J. Connolly at $6.49 per running ft.; C. K. Burdeau bid $6.50. The contracts for the Desiré St. and France St. levees were awarded to C. K. Burdeau at $6.25 and $6.

Breakwater.—*Rockland, Me.*—The following proposals for the construction of a breakwater were offered Dec. 2 by Lt.-Col. J. A. Smith, U. S. Engineer Office, Portland, Me.: W. S. White, Rockland, 78½ cts. per ton of 2,000 lbs. for stone furnished and placed, 98½ cts. per ton for taking up and relaying stone at shore end; Bodwell, Smith & Co., Rockland, 85 and 92 cts.; J. F. Hamilton, Portland, 81 and 65 cts.; W. P. Hurley, Rockland, 80 and 81 cts.; T. A. Rowe, Newton, Mass., 97 and 65 cts. The bid of W. S. White was recommended for acceptance.

PROPOSALS OPEN.

Depot.—*Detroit, Mich.*—Construction of Fort St. union depot. James Appleyard, Supt. of Construction. Hy. B. Joy, Secy., Fort St. Union Depot Co. Dec. 18.

Buildings.—*Kansas City, Mo.*—New city hall. S. E. Chamberlain, Superintendent of Buildings. Dec. 22.

Fern Bank, O.—Town hall. Architect, W. M. Aiken, 91 Johnston Building, Cincinnati. T. Forman, Pike Building, Cincinnati, O. Dec. 22.

Cincinnati, O.—Stone school house, 24 rooms. J. E. Cormany, Chairman of Building Committee, Board of Education, Public Library Building. Dec. 29.

Street Lighting.—*East Tawas, Mich.*—Electric lighting plant for streets and buildings. D. G. Lowe, Village Board. Dec. 19.

Frankfort, Ind.—Gas and electric lighting for 5 years. S. A. Cook, City Clerk. Dec. 19.

Highway.—Improving county road. John Hagerty, Auditor of Hamilton Co., Cincinnati, O. Jan. 10.

Bridge.—*Chicago, Ill.*—Howe truss swing bridge over south fork of Chicago River at 35th St. W. H. Purdy, Commissioner of Public Works. Dec. 16.

Jail.—*Kansas City, Mo.*—Steel and iron cells, etc., for Jackson Co. Architect, A. Van Brunt, 200 W. 6th St. Dec. 26.

Pipe.—*Toronto, Canada.*—Supply of pipe during 1891. The City Engineer. Dec. 23.

Street Work.—*New York, N. Y.*—Asphalt paving on present stone blocks and on concrete. Department of Public Works, 31 Chambers St. Dec. 16.

Sewers.—*Boston, Mass.*—Section 10 of Dorchester intercepting sewer. Wm. Jackson, City Engineer. Dec. 15.

New York, N. Y.—Department of Public Works, 31 Chambers St. Dec. 16.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Baldwin Locomotive Works, of Philadelphia, Pa., have built a mogul engine for the Northern Pacific R. R., and have an order for a heavy ten-wheel engine for the Marietta & North Georgia Ry. They are also building 6 compound engines for Brazil. The Richmond Locomotive Works, of Richmond, Va., have an order for 6 passenger, 3 freight and 1 switch engine for the Louisville Southern R. R. The Brooks Locomotive Works, of Dunkirk, N. Y., are building 6 engines for the Cincinnati, Wabash & Michigan Ry. The New York Locomotive Works, of Rome, N. Y., have an order for 8 mogul engines for the Wheeling & Lake Erie Ry. H. K. Porter & Co., of Pittsburg, Pa., have built a four-wheel motor engine, with cylinders 12 × 18, and weighing 23 tons, for the Milwaukee & White Fish Bay Ry. The New York, Lake Erie & Western R. R. will add 25 engines to its equipment, and the Cleveland, Cincinnati, Chicago & St. Louis Ry. will order 20 heavy freight engines. The Western Locomotive Co. has been organized at Seattle, Wash., to establish locomotive works.

Cars.—The Pullman Palace Car Co., of Chicago, Ill., has an order from the Philadelphia & Reading R. R. for 3,000 coal cars of 30 tons capacity, 1,000 gondola cars, 1,000 box cars and 50 stock cars; they will cost about $2,500,000. The company is building two drawing room cars and four ordinary cars for a New York and Boston express train over the New York & New Haven and New York & New England roads; it has also completed a private car on six-wheel trucks, for Mr. Austin Corbin. The Cleveland, Cincinnati, Chicago & St. Louis Ry. will add considerably to its freight equipment.

The Heisler Electric Light Co. announces the removal of its works from St. Louis to Gloucester, N. J. The reasons given are gain of enlarged space and increased facilities, necessary to meet a constantly increasing demand for their goods. The Heisler system makes it possible to distribute any number of lights, from 160 32 candle-power lights to the full capacity of the largest dynamo, over an area that could only be covered by 50 miles of No. 8 B. & S. gauge wire. There is no drop in the candle power and loss due to line resistance is only one 32 c. p. lamp per mile. The dynamo used has an efficiency of 6½ 32 c. p. lights per M. HP. expended, less the friction load of the dynamo. Another device is the combined automatic cut-out and lamp socket adapted to lamps from 10 to 150 c. p. The office is in the Drexel Building, Philadelphia, Pa.

A one-half interest in the Priest Flanger has been purchased by Mr. W. E. Haskell, of Minneapolis. Mr. Haskell will take active charge of the business management and reports inquiries and new orders as very promising.

The National Paint Works, Williamsport, Pa., report large sales of asphaltum paints. The paint has been used on the following large structures: Merchants' Terminal & Elevated Railroad, St. Louis, built by the Phœnix Iron Co.; the Philadelphia & Reading Terminal Bridge, at Harrisburg, Pa., 4,400 ft. long, built by the Cofrode & Saylor Co., and Orrien Bros.' circus and amphitheatre, in the City of Mexico, built by the Riverside Bridge & Iron Works, of Paterson, N. J.

The W. S. Dickey Clay Mfg. Co., of Kansas City, Mo., has removed its offices to the New York Life Building.

New Companies.—Western Locomotive Co., of Seattle, Wash., capital stock, $2,500,000; to establish locomotive works. Central Complete Combustion Co., of Jersey City, N. J., capital stock, $2,000,000; incorporators, Caleb R. Ayer, of Boston, Mass., and others; to manufacture locomotives, boilers, etc. Bear Magneto Electric Co., of Chicago, Ill.; capital stock, $3,000,000; incorporators, S. J. M. Bear, Wm. R. Northway, and Franklin Babcock. Standard Elevator Co., of Chicago, Ill.; capital stock, $300,000; incorporators, J. S. Root, Thos. Parker, Jr., and A. Christoferson; to manufacture elevators, machinery and architectural iron work. Hackolite Plaster Board Co., of Chicago, Ill.; capital stock, $350,000; incorporators, A. T. Otto, Frederick Keppler, Marcks Hitch; to manufacture fire-proof plaster and construct fire-proof buildings. Illinois Drainage and Irrigating Co., of Chicago, Ill.; capital stock, $50,000; incorporators, David A. Newmark, G. D. Fund, and T. C. Rogers. American Railway Traffic Association, of Chicago; capital stock, $10,000,000; incorporators, Geo. W. Cole, C. Porter Johnson, and Roy O. West; to establish and maintain a uniform system and schedule of railway passenger and freight rates. Newbern Pressed Brick Co., of Newbern, Ill.; capital stock, $100,000; incorporators, H. A. Fisher, F. E. Fisher, and S. A. Simons.

Metal Market Prices.—*Rails.*—New York: $28.50 to $29; old rails $22.50 to $23 for iron and $20 for steel. Chicago: $30 to $31.50; old rails, $23.50 for iron and $16 to $19.50 for steel. Pittsburg: $29 to $29.50; old rails, $27 to $27.50 for iron, and $17.50 for steel.

Foundry Pig-iron.—New York: $16.50 to $18. Chicago: $15 to $16.25. Pittsburg: $15.25 to $17.

Track Materials.—New York: steel angle bars, $1.70 to $1.75; spikes, $1.95 to $2; track bolts, 2.7 to 2.8 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.95 to 2.05 cts. for iron, 2 to 2.1 cts. for steel; spikes, 2.15 cts.; iron track bolts, 2.9 with square, and 3 cts. with hexagon nuts. Chicago: splice bars, 2.05 to 2.1 cts. for iron and 2.15 to 2.20 for steel; spikes, 2.25 cts.; track bolts, 3.1 cts. with hexagon nuts.

Pipe.—Cast iron, $27 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York, 4 to 4.15 cts. Chicago, 4.50 cts. St. Louis, 4.45 cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles 2.15 to 2.30 cts.; tees, 2.65 to 2.75 cts.; sheared iron plates, 2.15 to 2.25 cts.; steel plates, 2.35 to 2.50 for tank, 2.6 to 2.7 cts. for shell, 2.85 to 3 cts. for flange, 3.75 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; angles, 2.35 to 2.4 cts.; tees, 2.9 to 3 cts.; universal plates, 2.45 to 2.5 cts.; sheared plates, 2.5 to 2.6 cts. for iron and 2.6 to 2.7 cts. for steel. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2.25 cts.; tees, 2.85 cts.; universal iron plates, 2.3 cts.; sheared steel bridge plates, 2.55 cts.; refined bars, 1.9 to 2 cts.; steel plates, 2.35 cts. for tank, 2.75 cts. for shell, 2.95 cts. for flange, 4 to 4.5 cts. for firebox.

Sewer Pipe.

Sealed Proposals will be received by the Mayor and Board of Aldermen of the city of Winston, N. C., until 2 o'clock P. M. of Monday, Dec. 22, 1890, for furnishing about 4 miles of sewer pipe, from 6 to 24 ins. diameter, and fittings for same.

Specifications, approximate quantities, etc., may be obtained from the Chairman of the Sewerage Committee or the Engineer.

The right is reserved to reject any or all bids.

J. M. ALLSPAUGH,
Chairman Sewerage Committee.

J. L. LUDLOW, Engineer. 49-3t

Proposals for Sewers.

Sealed Proposals will be received by the Mayor and Board of Aldermen of the city of Winston, N. C., at the Mayor's office of said city until 2 o'clock P. M. of Friday, Jan. 2, 1891, for constructing a part of the propose i system of pipe sewers for said city.

Copies of the general plans and specifications, forms of proposals and instructions to contractors, and any information relative thereto may be obtained from the Chairman or Engineer of the Sewerage Committee.

The Committee reserves the right to reject any or all bids. J. M. ALLSPAUGH,
Chairman Sewerage Committee.

J. L. LUDLOW, Engineer. 49-4t

Raising Highway Bridge.

HAWKINSVILLE, Ga., Nov. 26, 1890.

Sealed proposals, in duplicate, will be received at the office of the County Commissioners of Pulaski County until 12 o'clock M. on Tuesday, the 27th day of January, 1891, for raising the highway bridge across the Ocmulgee River, at Hawkinsville. For all necessary information apply to D. G. FLEMING, Clerk of said Board of Commissioners, at Hawkinsville, Ga. 49-8t

Toronto Street Railway.

Sealed tenders addressed to the undersigned will be received by registered letter at the office of the City Clerk, Toronto, Can., up to noon on the 15th day of January, 1891, for the purchase or lease of the street railway tracks in the city of Toronto, with or without real estate, buildings, rolling stock and all material used in connection with the said railway, together with the exclusive right of operating the said railway on the streets of the city of Toronto. For further particulars and conditions of sale, apply after Dec. 1, 1890, to W. T. JENNINGS, City Engineer, Toronto, Can.

MILES VOKES,
Chairman Street Railway Committee.

TORONTO, Can., Nov. 19, 1890. 48—

Proposals for Vertical Pumps.

Sealed proposals will be received at the office of the Board of City Affairs, Cincinnati, O., until 12 o'clock noon of December 26, A. D. 1890.

For four vertical pumps of 5,000,000 capacity each in 24 hours. These pumps to take the place of similar size Wetherill pumps now in position, and to operate by the steam ends now in use. Each bidder is requested to examine and measure the well, and so design his work as to properly connect with the parts to be retained.

Each bidder will be allowed to furnish his own plan, drawings and specifications, with guarantee as to date of completion, and forfeiture for failure in time. Also, will be required to give proposition on plans and specifications furnished by the Board of City Affairs.

For particulars apply to Willis P. Tharp, Superintendent and Engineer of Cincinnati Water-Works.

The Board of City Affairs reserves the right to reject any or all bids.

By order of the Board of City Affairs.

THOMAS G. SMITH,
President.

Attest: D. W. BROWN, Clerk B. C. A.
48-4t.

PROPOSALS FOR DREDGING IN BELlamy River, New Hampshire. United States Engineer Office, Portland, Me., Dec. 8, 1890. Sealed proposals in triplicate for dredging in Bellamy River, New Hampshire, will be received at this office until 3 P. M. of Tuesday, Dec. 30, 1890, and then opened. Attention is invited to acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, vol. 23, page 332, and vol. 24, page 414, Statutes at Large. All necessary information furnished by JARED A. SMITH, Lieut.-Col. Corps of Engineers, U. S. Army. 50-3t.

S. E. NOBLE, Prest. JNO. E. WARE, Secy. and Treas. R. F. CARTER, Supt.

The Anniston Pipe Works,

MANUFACTURERS OF

CAST IRON WATER AND GAS PIPE,

ANNISTON, - - - - ALA.

Especially adapted for the Elevation of Clear, Gritty, Thick, or Acidulous Liquids, Quickly, Cheaply and Efficiently

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MONTAGUE & CO.,

MANUFACTURERS

FIRE BRICK, SEWER PIPE,

DOUBLE STRENGTH

RAILROAD CULVERT PIPE,

With long sockets, in two and one-half foot lengths.

CHATTANOOGA, - - - TENN.

DOUBLE STRENGTH
SEWER & CULVERT PIPE.

MONMOUTH MINING & MFG. CO., MONMOUTH, ILL.

PROPOSALS FOR RIP-RAP GRANITE—Engineer Office, U. S. Army, Newport, R. I., Dec. 5, 1890.—Sealed proposals, in triplicate, for furnishing and placing Rip-Rap Granite in the eastern jetty at Nantucket, Mass.; the north wall of the inner harbor at Block Island, R. I.; the Breakwater at Point Judith, R. I., and the Eastern Breakwater at Stonington, Conn., will be received at this office until 12 o'clock, noon, on Monday the fifth day of January, 1891, and then opened. The attention of bidders is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. The United States reserves the right to reject any or all proposals and to waive any informalities. Full information will be furnished on application. W. R. LIVERMORE, Major of Engineers.
49-4t.

PROPOSALS FOR CONSTRUCTION OF breakwater and beacon at Little Harbor, N. H. United States Engineer Office, Portland, Me., Dec. 1, 1890. Sealed proposals, in triplicate, for construction of breakwater at Little Harbor, N. H., will be received at this office, 537 Congress street, until 3 P. M. of Tuesday, Dec. 30, 1890, and then opened. Attention is invited to Acts of Congress, approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. All necessary information furnished by JARED A. SMITH, Lieut.-Col. Corps of Engineers, U. S. Army. 49-2t, 52-1t

TO VESSEL OWNERS—ENGINEER Office, U. S. Army, Newport, R. I., Nov. 24, 1890. Vessels equipped for handling stone are required for the Government work at the Harbor of Refuge at Block Island, R. I., Stonington, Conn., and other points. Owners or parties interested who desire to charter such vessels to the United States, or to freight stone by the ton, are invited to communicate with this office. Their attention is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, vol. 23, page 332, and vol. 24, page 414, Statutes at Large. W. R. LIVERMORE, Major of Engineers. 48-4t

Long Leaf Yellow Pine.

For bridges, trestles, and car building. Mills in belt of the finest South Georgia yellow pine timber. Orders promptly filled. Address, C. J. HADEN,
Secretary and General Manager, Hosch Lumber Co., Clark Lumber Co.
Atlanta, Ga.

WRECK OF SCHOONER "S. S. BICKmore," Engineer Office, U. S. Army, Newport, R. I., November 26, 1890. To whom it may concern: Whereas, navigation is obstructed and endangered by the wreck of the schooner "S. S. Bickmore," lying about halfway between the wharf and the west end of the breakwater in Hyannis Harbor, Mass.; notice is hereby given to all persons interested in said vessel, her cargo and all other property therein, that if, within thirty (30) days from the date of this advertisement, they shall not have signified to me their intention and taken preliminary steps to remove said wreck, etc., as soon as practicable, the same will be considered as abandoned and derelict, and it will be removed by the United States under authority of law. Sealed proposals in triplicate for the removal of said wreck will be received at this office until 12 o'clock noon, on Saturday, the 27th day of December, 1890, and then opened. The attention of bidders is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. The United States reserves the right to reject any or all proposals and to waive any informalities. Full information furnished on application. By authority of the Secretary of War. W. R. LIVERMORE, Major of Engineers. 48-4t

PROPOSALS FOR DREDGING IN NARraguagus River, Belfast Harbor, Camden Harbor, and for dredging and removing ledge in Rockport Harbor, Maine. United States Engineer Office, Portland, Me., Dec. 1, 1890. Sealed proposals, in triplicate, for dredging in Narraguagus River, Belfast Harbor, Camden Harbor, and for dredging and removing ledge in Rockport Harbor, Maine, will be received at this office, No. 537 Congress street, until 3 P. M. of Tuesday, Dec. 30, 1890, and then opened. Attention is invited to Acts of Congress, approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. All necessary information furnished by JARED A. SMITH, Lieut.-Col. Corps of Engineers, U. S. Army. 49-2t, 52-1t

ENGINEER OFFICE, U. S. ARMY, NEWport, R. I., Nov. 24, 1890. Dump scows of 200 to 300 cubic yards capacity, wanted for use on the improvement of Hyannis Harbor, Mass., and elsewhere. Parties having them to let can obtain full information by addressing the undersigned. Their attention is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, vol. 23, page 332, and vol. 24, page 414, Statutes at Large. W. R. LIVERMORE, Major of Engineers. 48-4t

Royal Siamese State Railways.

NOTICE.

It is hereby notified for general information that TENDERS in the form of a schedule of rates for each class of work required will shortly be invited for the construction of the ROYAL SIAMESE STATE RAILWAYS from the capital of Bangkok to Bang-Pa-In, Ayuthia, Saraburi, and Korat, 268 km.

The works will be let out either in sections of from 70 to 100 km. or given to a general contractor.

The tenders will include all works and supplies necessary for completing the said railways, exclusive of the supply of permanent way and telegraph material, rolling stock, machinery and furniture, which will be provided by the Royal Siamese Railway Administration and delivered, when required, to the Contractors in the depots at Bangkok and Ayuthia.

In every other instance, the contractors are expected to supply themselves with all the necessary plant, such as tools, small railways for earth and other provisory transport, excavators, pumping and ramming machinery, etc., etc.

Those intending to tender are advised to personally examine the line and the plans, which may be seen from the 1st January, 1891, at the office of the Royal Railway Department in Bangkok.

The following figures represent approximately the amount of the principal works to be tendered for:—

Earthwork (stiff clay), 4 millions of cu. m.
Cutting in hard limestone rock, 200,000, cu. m
Retaining walls (rough rubble), 5,000 cu. m.
Masonry in abutments, 50,000 cu. m.
Timber for bridges, 8,000 cu. m.
Fourteen stations with wooden buildings, 11 of which are very small, etc., etc.
Gauge, 1,435 m. = 4 ft. 8½ in., English.
Weight of rails, 30 kg. per meter.
Sleepers, teak or red wood (maideng) 250 × 15 × 20 cm. = 8 ft. × 6 in. × 8 in., English.

The line runs for about 75 kilometers (km.) through the low alluvial plain of the Meinam, on an embankment from 2 to 4 m. high and is easily accessible by water.

From km. 75 to 136 the railway is accessible by land and runs nearly level with the ground.

From km. 136 to km. 180 the line is only accessible by pack animals (bullocks), and that only during the dry season (December to July).

At km. 136 the line enters into valleys along which it ascends to the table-land of Korat (300 m. above sea level, summit 394 m.) with gradients of 15 per mile, and curves of 180 m. radius through a splendid forest affording any quantity of wood which may be cut for the construction free of charge.

At km. 180 the table-land is ascended, and from there to Korat the line is again without any difficulties, with easy gradients and curves nearly level with the ground.

As regards the climate, it may be mentioned that in January the temperature in the mountains goes down to 50° Fahr. during the night.

Time of construction: Two years from date of agreement for the Bangkok-Ayuthia section; four to five years up to Korat.

By order of the Minister of Public Works.

K. BETHGE,
DIRECTOR GENERAL OF RAILWAYS.
49-4t

UNITED STATES ENGINEER OFFICE, 34 West Congress street, Detroit, Mich., Nov. 28, 1890. Sealed proposals, in triplicate, for furnishing all materials and labor and building the masonry of a lock at St. Mary's Falls Canal, Michigan, will be received at this office until 2 o'clock P. M., Jan. 27, 1891, and then publicly opened. Preference will be given to materials of domestic production or manufacture, conditions of quality and price (import duties included), being equal. Attention is invited to Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, vol 23, page 332, and vol. 24, page 414, Statutes at Large. The Government reserves the right to reject any or all proposals; also to award the contract upon other considerations than the price. For further information apply at this office, or to the U. S. Engineer Office, Sault Ste. Marie, Mich. O. M. POE, Colonel, Corps of Engineers, Lt. Col. Brig.-Gen. U. S. A. 48-6t.

U. S. ENGINEER OFFICE, 905½ E. Main street, Richmond, Va., Nov. 25, 1890. Proposals for dredging in the James River, Va., near Richmond, and at Kingsland Reach, will be received until noon of Dec. 22, 1890, and then opened. The attention of bidders is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, vol. 23, page 332, and vol. 24, page 414, Statutes at Large. All information can be had of the resident Engineer, Mr. C. P. E. Burgwyn. WM. P. CRAIGHILL, Colonel of Engineers, U. S. A. 50-3t

For other Proposals See Page XIV.

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OFFICE OF THE CHIEF ENGINEER,
AMERICUS, Ga., Aug. 8, 1890.
R. E. HARDAWAY, Chief Engineer.

Messrs. Keegan & Halpin, 46 Washington Street, New York City:

DEAR SIRS: I used four of your lights for steam shovel work at night some time since and they gave entire satisfaction.

Yours very truly,
B. E. HARDAWAY, C.E.

(Copy.)

WEST VIRGINIA IMPROVEMENT CO.
WESTON, W. Va., June 24, 1890.

Messrs. Keegan & Halpin, 46 Washington Street, New York:

GENTLEMEN: Replying to your favor of 21st inst., the light you sent us has thus far given satisfaction, and I can see no chance for improvement in it.

Yours truly,
J. A. FICKINGER, Ch. Eng.

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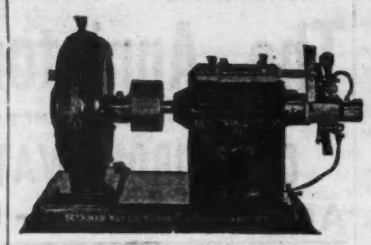

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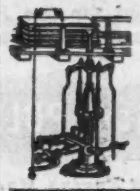

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SITUATIONS VACANT.

WANTED.—Draughtsman for general mechanical work; familiarity with wrought iron construction and hydraulics is preferred. Address in writing, giving details, CAMDEN IRON WORKS, 400 Chestnut Street, Philadelphia, Pa. 50-1t

WANTED.—An engineer, 31, experienced in railroad location and construction, and having had charge of heavy work, as tunneling, heavy rockwork foundations, masonry and bridge erection, also of maintenance, desires a position. Best references. Address CIVIL ENGINEER, P. O. Box 568, Albuquerque, N. M. 50-4t

MISCELLANEOUS.

WANTED.—2,000 bbls. Portland cement, delivered on boat at New Orleans about Nov. 15. Tensile strength, 300 lbs. one day in air, six days under water. McCORMICK & O'MEARA, 104 Olive St., St. Louis, Mo. 40–

WANTED.—We will send a copy of "Cross' Engineer's Field Book" in exchange for ENGINEERING NEWS of Aug. 2, 1890. Address Engineering News.

WANTED.—Good transit. Must be cheap. A. B. WILL, Room 1, 91 Washington Street, Chicago, Ill. 48-3t

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WANTED.—An engineer who expects soon to finish his present engagement desires position on location, construction or maintenance of way. Twenty years experience; 40 years old. Address C. E., Engineering News. 36–

WANTED.—As engineer or assistant on city or improvement work. Experience in Boston and the South. References given. Address E., care Carrier 293, Roxbury, Mass. 46-5t

WANTED.—A position as engineer, superintendent, or assistant superintendent, if works are large, of a water-works system, by a young man, experienced in designing, building and maintaining such works. Good references as to character and ability. Address J. G., care of Engineering News. 48-3t

WANTED.—A water-works engineer, aged 31, now acting as superintendent and of good address, responsible, energetic, understands water-works construction, steam and water-power pumping machinery; can prepare plans and make accurate estimates; can address a public meeting or canvass a committee; wants a position with a first-class firm of water-works contractors. Address CONTRACTING AGENT, care Engineering News. 49-2t

WANTED.—Inspection of important bridge work from parties willing to pay for experienced engineer. INSPECTOR, care Engineering News. 49-3t

WANTED.—Manufacturers who are desirous of being represented in the Maritime Provinces are requested to correspond with ALEXANDER POTTER, Halifax, N. S., Acting Manager of a Manufacturers' Agency to open Dec. 1. 49-3t

WANTED.—Position by an experienced and capable draughtsman, up to the times on plate and structural work and blast furnace construction. Please address BROWNSON, care Engineering News. 49-3t

WANTED.—Employment by a locating engineer with 17 years' experience on surveys and the location of railroads. Age, 37. Having made location a business I think I can merit the confidence of those needing such work done. Give me a trial and if you are not suited with my work no charge will be made for my effort. Address H. SHOFF, Burlington, Kan. 49-3t

WANTED.—A draughtsman of some years experience in the U. S. Engineer Corps, under Gens. John Newton and Q. A. Gilmore, wants an engagement. A fine letterer. Specimens of work and testimonials furnished. Address R. P., at this office. 49-3t

WANTED.—A gentleman of known and recognized ability and of many years' experience as a gas and water supply engineer and manager, is open for an engagement, either as general manager for a firm or syndicate operating a number of works, or as engineer and superintendent of a good water or gas plant; or would accept a good lucrative position with a manufacturer of water or gas works supplies. Has a very large acquaintance and is master of the business in all of its details. Address WATER AND GAS, care Engineering News. 49-3t

WANTED.—A position with engineering corps as transit observer or leveler, on preliminary or location, or as instrument man on maintenance of way. References. Address H., care Engineering News. 49-4t

WANTED.—Position on location, construction or maintenance of way. Fifteen years' experience, 37 years old, correct habits, graduate. Address C. E., 15, Engineering News. 49-4t

WANTED.—$100 *per month, or more,* will secure the services of a young, energetic and *practical* civil engineer, who has also a good technical education; references; at present employed in the Southwest. Address "D. K." care of Engineering News. 50-1t

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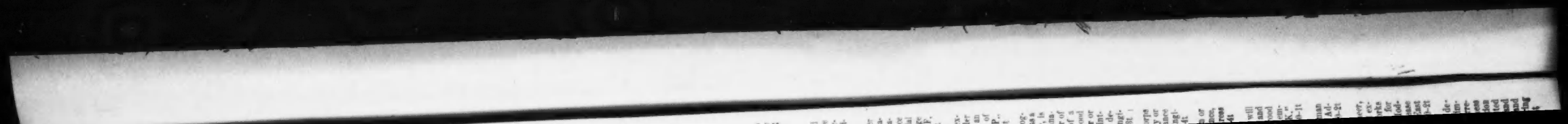
WANTED.—An engineer having charge of designing and superintending the ironwork for important fire-proof structures wishes to correspond with reliable parties to make a business combination, or would accept a salaried position for sufficient inducements. Is well acquainted with architects, engineers and contractors, and has had extended experience in estimating and soliciting contracts, RELIABLE, care Engineering News. 50-4t